THE

INDIAN FORESTER.

Vol. XIX.] January, 1893. [No 1.

Cardamoms in Coorg.

The Cardamom cultivated in Coorg is the *Elettaria Cardamomum*, and though the trade, so far as native cured fruit is concerned, is steadily falling, still the cardamom is an important article to the people and is certainly the cause of much thought and anxiety to the Administrators of this little Province.

~~I will not~~ give any botanical description of the cardamom in this article nor will I refer to the other kinds which are not utilised, but endeavour to give an idea of the habitat of the plant and the methods of curing it followed by the people, with a few remarks on the state of the cardamom trade.

The cardamom grows best on the Western and Northern slopes of the ghats at an elevation of from 3,000 to 5,000 feet above the sea. Here the full burst of the monsoon strikes the steep sides of the hills and the rainfall reaches as much as 300 inches in some parts. It grows spóntaneously, but is one of those peculiar plants, the seed of which lies dormant till induced to germinate by the occurrence of certain conditions. One of these is the admission of light. Cardamoms will only be found in the dense evergreen forest, and the ordinary method of inducing them to appear is to open a small space in the forest by felling one or two very large trees. Not only does this admit the light but the fall of the trees shakes the ground and breaks the surface. So thoroughly is the necessity for the shaking of the ground believed in, that when a plot is selected, all undergrowth, small trees, &c. which might interfere with or break the fall of the giant selected for destruction, are cleared away so that the tree may descend with all its weight and momentum : and to intensify the effect, the tree is always felled so as to face down hill. As these plots are almost invariably situated on the steepest hills, the effect of the fall of one of the enormous trees so common in the Ghat Forests must be very grand.

A Cardamom Estate is called a "malé" and the ordinary method of cultivating a "malé" among the Coorgs, is to open out

a certain number of these plots within the limits of the same. The plots are necessarily small, for only a limited amount of light is required and a plot too large, in addition to admitting too much light, would also allow of evaporation from the soil to an injurious extent. In the leases given for "malés" the maximum size of each plot is fixed at one-sixth of an acre and at least thirty feet of forest must be left between any two plots. As a rule not more than two trees are felled and oftener only one. The felling generally takes place in February or March in the year and by the rains the young plants shoot up. They require weeding at least once before they begin to yield, which takes place in the third year. The plant continues to bear for seven or eight years, the fourth and fifth and sixth of its age being its best. When it begins to cease bearing, either a new plot is selected or another tree is felled which seems to give a fresh start to the plant.

The position of these "malés" is generally so remote and inaccessible that the picking of the crop is undoubtedly no easy task. In fact, the Coorgs lose a large proportion of the crop, for the fruit begins to ripen as early as July, while they never attempt to pick before well into September. The tremendous rainfall not only, in itself, deters them from penetrating the hills, but renders the numerous streams and torrents impassable. Indeed, on the exposed slopes of the Ghats, life would scarcely be liveable in the height of the monsoon. As it is, the leeches in these forests throughout the autumn and cold weather months must be seen to be appreciated, and in addition to these drawbacks, the steepness of the hills is such that walking is difficult. When climbing about these "malés" one can quite comprehend the feelings of a fly walking up the side of a house.

The cardamoms are picked and sun-dried. If the malé is far from the village, the drying takes place on the spot, otherwise the capsules are taken home. Four days sunning is sufficient, care being taken that they do not get wet and that they are not over exposed, as this latter would cause the capsules to burst. But beyond this open air drying, no further curing takes place. The fruit stalks are rubbed or picked off. In this part of the process, it is wonderful the number of capsules a practised hand will clean in any given time. The capsules are then assorted according to size and colour and stored away till disposed of. But a better system of both cultivation and curing has been introduced into Coorg by an English planter in the ghats. I am much indebted to Mr. Finlayson for his having put at my disposal the necessary information concerning his treatment of cardamoms. In the first place, the cardamom plant is raised from seed in a nursery and the plants are put out in a compact plantation, instead of being allowed to grow spontaneously in scattered clearings. The first step is to prepare the area which is to be made into a cardamom plantation. This is done by thinning the shade. The amount of thinning can only be determined on the spot and is guided by experience. The

aspect chosen is generally North or North West and the most favourable places are the moist hollows and ravines. The undergrowth is cleared, and planting is done in June and July, from nursery plants raised from seed, supplemented by bulbs from old stools, Mr. Finlayson prefers the latter as growing better. The plants are put out at 7 feet by 7 feet, not deep in the soil. The plants are put into shallow pits which have been filled with surface mould, the soil is pressed round the half exposed bulb and the plant tied to a stake.

These Cardamoms yield a small crop the third year after being put out and they do not come into full bearing until the fifth year, thus there is no advantage in time in this method of cultivation. The yield then is about half a seer to each plant. Thus an acre would give about 475 seers, or say, 950 pounds ; under half a ton. The picking lasts from July to January, September and December being the busiest months. The first crop always yields the largest fruit.

Before preceeding to give Mr. Finlayson's method of curing, I will venture on a comparison of the advantages resulting from the two systems of cultivation, the native one by means of isolated and scattered openings in the forest, and the English one of a regular plantation. As to the former, the only advantage that can be claimed, and I am not certain that the claim should be allowed—is that it does less harm to the forest which, as the Ghaut Forests should be preserved for climatic reasons, is a very important point. Mr. Dickinson, whose knowledge of the conditions of cardamom cultivation owing to his personal inspection of the malés and ghaut forests is unique, is in favour of the native method on the ground of less damage being done to the forest. He argues that the partial clearing of the high forest over a comparatively large area accompanied by the removal of the undergrowth, tends to set up scouring and that the soil will be all washed away. But the drawback to the native system is the difficulty of supervising the work and of enforcing the rules as to the size of the plots and the width of the belt of forest to be left between each plot, and though it is in the interest of the malé holder not to open the forest to too great an extent, it is a question whether, with the low prices ruling in the cardamom market, the urgent necessity of raising a large crop will not, and does not, tempt malé holders into over-felling, leaving the future to look after itself. Where a forest has been over-felled under the native system, the damage is practically irreparable. It is with very great diffidence that I differ from one so well up in the subject as Mr. Dickinson, but I have seen both systems of cultivation and taking all the conditions obtaining, I am decidedly in favour of the English method of cultivation, as it is more easily and effectually supervised, it concentrates the damage done into a smaller area, the crop is more easily and more cheaply picked and the whole working of the estate more in accordance with science.

Mr. Finlayson dries the capsules partly by exposure to the sun and partly by artificial heat. The former is the better method, but, owing to the uncertainty of the weather, the latter, in the end, pays better. The cardamoms are bleached by exposing them to the dew for a couple of nights and then fumigating them with sulphur. Mr. Finlayson is naturally somewhat reticent as to the process his cardamoms pass through, for the supply is large and the market restricted and the competition from Ceylon, Travancore and Mysore is keen. Before picking, the capsules are carefully sorted and clipped. I am unable to give the cost of cultivating, picking and curing the cardamom under this system. It is finally packed in boxes and sent to the market.

The price of cardamoms has been steadily diminishing of late years. Rs. 14, to perhaps 'in a few instances' Rs. 18, per maund of 28 lbs., is the average selling price of native-cured cardamoms. The English cured sell from Rs. 1-8-0 to Rs. 2-4-0 per lb. The system in force in the days of the Coorg Rajas as regards the disposal of cardamoms was that the whole crop was handed in to the Government, who paid the cultivators a fixed price per maund and sold the crop for itself. The price paid was from Rs. 12 to Rs. 20, per maund. This was continued after the annextion of Coorg until 1846, when the malés were put up to auction and they are now leased, tenders being invited for a certain period of years. There is another class of malé in Coorg the Jama malé—the holders of which have a right to the produce on payment of rent which is assessed on the estimated yield.

The prospects of the native cardamom cultivators are extremely gloomy. Owing to several causes, the cultivators have been having a bad time of it lately. Falling prices, the enfranchisement of their slaves which necessitates payment of labour, and bad seasons, have all combined to render it impossible for many of the lessees to pay the rent they covenanted to six years ago. So bad has been their condition that the Local Government has had to allow a large number to resign and the condition attached to the acceptance of the resignation *viz.*, the payment of all arrears, has been found difficult to enforce.

It is a matter of extreme regret that a comparatively large number of families should lose their principal means of livelihood, but it is useless for the State to endeavour to oppose the laws of economics. Want of capital prevents these small malé holders from cultivating and curing their cardamoms in a paying way. The outturn is so poor in quality that it necessarily fetches a very low price when the beautifully cured capsule of the English grower is competing with it, and the problem will soon work itself out with this result, that the producers of native cured cardamoms will become fewer and fewer, until the produce they put on the market only suffices for the demand. For, strange to say, despite its inferior value and condition, there is still a demand for this kind and always will be, as long as there are people who, though desirous

of purchasing, can only afford to pay low prices and must therefore, perforce, put up with an inferior article. The slow extinction of the *malé holder is a serious loss to the Forest Revenue, but, I fear,* go he must, and the Department must look around for some fresh source of revenue to make up the deficit.

G. H. FOSTER.

ON CERTAIN EXPERIMENTS

MADE IN THE

Forest Nursery at Bellefontaine (near Nancy.)

by E. BARTET, Inspecteur Adjoint des Forêts.

The facts set forth in the following notes are the results of *experiments carried out in the Bellefontaine Nursery on the* raising of plants for forest planting. The nursery which was established in 1863 in the Forêt de Haye, nearly four miles from Nancy, and whose situation is defective from several points of view, constitutes one of the experimental stations attached to the Nancy Forest School.

Whether the observations which I have collected contain anything new and hitherto unpublished, and whether the reader will find in them anything other than the confirmation of facts already made known, I do not venture to affirm, so considerable are the numbers of works carried out in France and elsewhere on the subjects herein dealt with.

(1). On the use of sawdust and peat for covering small seeds.

At Bellefontaine, for covering small seeds, a mixture of mould leaves, well decayed manure and sifted earth, has for a long time been used. The preparation of such a compost is costly, the use of it has also other inconveniences, for when a period of drought follows after prolonged rain, it gets hard and forms a crust liable to interfere with the growth of small plants.

These considerations led me to try whether, for covering the seeds in question, sawdust and peat could not be used, these being two substances often obtainable in abundance and at a low price in the neighbourhood of forest land.

The first experiment to this end was made in April 1887 :— six trenches each 30 feet long being sown with Spruce Fir. The following were compared :—

1. Sawdust of Poplar, alone.
2. Peat alone.
3. A mixture of one part Poplar sawdust and one part mould.

4. A mixture of peat and leaf mould, in equal quantities.
5. A mixture of peat and sawdust, also in equal quantities.
6. The usual compost consisting of one fourth part leaf mould, one fourth decayed manure and one half well sifted mould.

Before using the sawdust, it was carefully saturated with water.

The results were quite as satisfactory in Nos. 1 and 2 as in the other lines and that as much so during the period of germination, as during the rest of the season of vegetation. It was even noticed that under nothing but sawdust, the seedlings of Spruce made their appearance earlier and more completely than anywhere else.

In the spring of 1888, another trial was made of the comparative effects on Spruce seed of sawdust alone and of the compost above mentioned, No. 6. The advantage was again on the side of the sawdust, although this had not been specially watered before using, it having been simply exposed to the rain for six months.

Finally, in the same year, 1888, the best and most conclusive results were furnished by a trial made on Spruce seed of very fine sawdust, not made from species such as Poplar, but from Oak. In spite of its being watered every two days, the working of the tannin into the soil in no way retarded either the germination of the seeds or the subsequent growth of the living plants.

It is therefore almost certain that sawdust derived from almost any species whatever might be employed in this way, provided that it is well saturated with water at the time of its being used.

When the sowings are made in lines, rather less than a pint of dry sawdust is required for a foot of trench.

(2). On sowing Oak seed in autumn.

The following process which is both simple and economical, has been entirely successful each time I have tried it. The sowing is made immediately after the natural fall of the acorns.

To preserve these from the attacks of rodents, they are coated with redlead by shaking them up in a bag or basket of this after wetting them.

After the acorns, well covered with this protective coat, have been dried, they are sown in trenches 1½ to 2 inches deep, about an inch of sawdust (wet or dry) well pressed down, being first placed over them and then about an inch of earth over that forming a slight mound. Thus protected, the acorns suffer nothing from the cold and the young plants appear at the beginning of June with the greatest regularity.

(3). Advantages of sowing Birch seed in autumn.

It is well-known that many authors recommend sowing Birch in autumn immediately after the ripening of the seed, in order to prevent its losing its power of germination. The experiment shows how thoroughly this advice was justified for the autumn sowing gave ten times as many plants as the spring sowings.

(4). Destruction of mole crickets.

Ever since I have had charge of the Bellefontaine Nursery, I have had to deal with a formidable invasion of mole-crickets which has given me the opportunity of experimenting on the various methods recommended by experts for the destruction of these pests.

With the exception of hunting for their nests and for the holes in which they take refuge, the only method which has been successful is that which consists in placing small pots with smooth and almost vertical sides, in the earth, in such a manner that the insects may fall into them in the course of their noctunral ramblings.

To place these traps along all the galleries would be practically impossible when one has to deal with thousands of these enemies. In such a case it is found best to proceed as follows.

The parts most infested should be enclosed with boards placed edgewise and buried 1½ inches in the soil, about 1 inch of their width remaining above ground. When the area thus enclosed is more than 120 square yards, it should be divided into compartments by a number of boards similarly disposed to those above mentioned.

It is then all along the sides of these boards inside and out that the pots are placed at 15 to 20 ft. distance one from the other taking care that the edge of each pot is a little below the level of the soil and that it touches the board very exactly.

In constructing their galleries the mole-crickets run against the planks and turn aside along these until they fall into the traps laid for them and from which they can be collected every morning.

The pots of the shape of an ordinary plant pot are the best, they only need to be about 6 inches deep and about the same width at the top, the bottom having a diameter of about half that. The hole to receive these can be conveniently made with a piece of wood previously prepared to the required shape and size.

It is perhaps superfluous to add that if ordinary plant pots are used, the hole at the bottom must be plugged up with something sufficiently hard to prevent the insects getting through.

Pots with thick rims should not be used, as with these the edge of the pot cannot be placed exactly against the plank.

Finally the pots must be kept free from earth, leaves and rubbish or the insects may escape.

(5). Trials of chemical manures.

.... The results were not conclusive.

(6). Treatment of the red disease in Pine leaves.

At the commencement of the year 1888, I published, together with Doctor Paul Vuillemin, the result of experiments showing the efficacy of copper compounds for preserving the Scotch Pine against the "red" disease which is due to the attacks of the fungus *Histerium Pinastri*, (Schrad.) which affects exclusively the leaves of the year.

In these first experiments of 1886 and 1887 I restricted myself to the Scotch Pine, and the Bordeaux mixture used in these experiments contained according to the primitive formula of M. Millardet, 16 pounds of sulphate of copper, 32 pounds of lime and about 3 lbs. of isinglass to about 22 gallons of water. This paste was applied to the plants like whitewash, twice a year, with broom or brush.

On continuing the study of this question, I ascertained that at Bellefontaine the Black Austrian Pine was affected almost in the same degree as the Scotch Pine and that the seedlings of these species were liable to be attacked and killed by the fungus within the year of their germination. I also made fresh trials to compare different copper compounds and different modes of employing them also varying the number of applications per annum.

These trials, of which the details cannot be enumerated here, led me to the following conclusions.

1. Of the various formulæ of Bordeaux mixture capable of being utilized, the two following gave the most satisfactory results.

No. I.	Sulphate of Copper ...	... lbs.	8
	Lime ...	... ,,	8
	Isinglass ...	... ,,	2½
No. II.	Sulphate of Copper ...	... ,,	12
	Lime ...	... ,,	8
	Isinglass ...	... ,,	2½

Both the above are quantities per 22 gallons of water. Formula No. I. should be used for the first or two first applications made at the beginning of the season of vegetation, when the young needles are still young and might suffer from a too concentrated wash of the sulphate. Formula No. II should be used in subsequent applications.

In raising the quantity of sulphate of copper to 16 lbs. without increasing the amount of lime, I noticed that the leaves were burnt.

2. Burgundy mixture (sulphate of copper, and carbonate of of soda 2½ lbs. of each to every 22 gallons of water) I found less efficacious than the Bordeaux mixture, probably on account of the smaller proportion of sulphate used.

3. Copper sulphosteatite (made by mixing powdered talc, sulphate of copper and water) much used by vine growers in the South of France to prevent mildew, gave but poor results in spite of

washings made every 15 days. The smooth leaves of the Pine are not able to retain this powder long in the wet climate of Bellefontaine.

4. The Bordeaux mixture can be applied either like whitewash with a brush or by means of a sprinkler such as is used for the treatment of mildew in the South. What is important is that each leaf should receive a wash of the mixture.

The use of a sprinkler is the more economical mode.

5. In dealing with either Scotch Pine or Austrian Pine, treatment with a view to the prevention of the red disease should be begun while the plants are yet in their first year of growth and must be continued so long as they remain in the nursery.

For seedlings under one year old, the first application of the mixture is made a few days after the appearance of the plants above ground ; for those of one year old or more it is better to wait till the new needles have attained about $\frac{1}{3}$ of their length. The other applications are made at intervals of three weeks or a month ; they should be more frequent at the beginning of the season of vegetation than in the middle of summer ; exceptionally abundant rain may also render more frequent applications necessary.

At Bellefontaine, where this disease has prevailed for some time and has exceptionally favourable conditions for its propagation, 3 or even 4 applications should be made every year, when the latter part of the spring and the beginning of the summer are wet.

(7). Seed of the Weymouth Pine.

.... Weymouth Pine seed should not be sown in a Nursery without first putting it through a process of preparation by some method or other of 'stratification.' This is excellent advice and I think with M. Pierret (the author of the above) that the practice of stratification would be of great advantage for many other species as well, both broad-leaved species and conifers, and more particularly for the larch and beech.

So far as concerns the Weymouth Pine, each time I have sown it, after simply having submitted the seed to immersion in water, the results have been unsatisfactory, even with a previous immersion of 15 days, the soil also being irrigated. Under such conditions, sowing the seed at the end of April or commencement of May, I have always noticed the following peculiarities.

Germination took place slowly, commenced before the middle of June, and continued until August, the crop of seedlings being anything but abundant ; the seed is thus exposed for some time to the attacks of rodents and birds. Moreover, whatever precautions are taken, several of the young plants are destroyed as they appear, either by birds or yb the heat, whereas those that come up latest succumb to the cold of winter. Finally, only about 17 plants remain per square yard of ground sown. As compared with this, last year I obtained a most successful result by means of stratification carried out as follows.

In order to avoid any chance of mould later on, the seeds were first placed in a solution of sulphate of copper (3 per cent concentration) for 24 hours, then on the 12th of March, the seeds were spread in a bed ¼ inch thick between two layers of wood sawdust well wetted, each layer being 1 to 1½ inches thick.

The box containing the whole was then placed in a room dimly lighted and not warmed, care being taken to maintain the moisture of the sawdust by occasional light waterings.

On the 14th May, *viz.* two months later, the first signs of germination appeared. The seed was then separated from the sawdust and sown in trenches. In less than 15 days the young plants came up in masses in as great abundance as is the case with Scotch or Austrian Pine.

(8). Peculiarity of Elm Seed.

It is well-known that when Elm seed is sown immediately after its dissemination (May or June), the young plants appear after some days. To obtain the best results, the seed has, however to be covered but lightly.

If, on the contrary, the seed is covered with a layer of 2½ to 2¾ inches of earth, as I covered it in an experiment made in 1890, but few plants appear in the same year, the majority of the seedlings coming up in the spring of the year following the sowing. Moreover, the total number of plants obtained is less than that furnished by the method of covering lightly.

Perhaps the above may be of use in arriving at some practical method of preserving Elm seed.

(9). *Cutting back of badly grown Oak plants.*

The Oak plants referred to here were taken out of the Nursery at Bellefontaine when one year old and replanted in a temporary nursery in the Forêt de Haye where, during the two following years (1885 and 1886). they were so seriously damaged by spring frosts that the stems of many of them practically did not develop at all.

Towards the end of April 1887 it was considered necessary to transfer them to another temporary nursery less exposed to frost that the first.

The smallest and most badly grown of the plants (many of which were barely 3 inches high) were cut back level with the ground immediately after transplanting, while the larger ones, measuring 8 to 10 inches were transplanted and left just as they were.

Two years later the shoots of those which has been cut back constituted a group as vigorous and of as favourable an appearance as the others. It was even among them that the largest plants were to be found.

The result of the cutting back was therefore excellent. Is must always, however, be remembered that if this operation it

intended to re-establish equality in the size or more correctly in the height, of the stems, it is not capable of *producing the same effect* in the weight of the plants. This is shown by the following figures furnished by two groups of eight oaks thoroughly representative of the two lots compared.

	Plants which were cut back.	Plants not cut back.
Average height of stem above collum ...	*21 in.*	*21 in.*
Average weight of an air-dried plant (stem and root) ...	$\frac{3}{4}$ oz.	1 oz.

This difference in the weight *of the plants arises from the* root system as well as the aërial organs, for plants which were not cut back were manifesty more thick set, better branched and better *provided with roots than those* which had been cut over.

(Translated and abridged by A. F. G.)

NOTE.—It is perhaps hardly necessary to remark that the inferiority of the root system of the plants of the first lot should not be attributed to the operation of cutting back, *for not only did this inferiority* exist at the time of the operation but it was much more pronounced then, than at the time of the weighing above referred to.

The Cutch tree in Upper Burma.

At present the only protection afforded to Cutch is *(i)* it may not be felled for sale or use as fuel ! *(ii)* no cutch trees under three feet in girth may be cut for cutch boiling. With these two exceptions, Cutch trees may be cut wholesale for sale or use as house posts, cart-axles, &c.

This hard-and-fast sort of girth restriction is not capable of practical application. Right in the centre of Burma, from the north of the Magwe, Minbu and Pyinmana districts up to the north of the Mandalay district, there is a ' dry zone ' embracing the eastern parts of Minbu, and Pakokku, the South of Sagaing and Mandalay, the western parts of Kyaukse, and the whole of Yamethin, Meiktila and Myingyan. With this dry zone there are hardly any true forests, as we are accustomed to find them in the moister parts of Burma. Where not under cultivation, the soil is covered with an open scrub jungle in which many species of Acacia are noticeable. Even with the isolated positions of the stems and the consequent full development of crowns, with full enjoyment of light and air, the rate of growth and the development of and quality of the cutch-producing heart wood are both inferior to that in the moister tracts of South Pyinmana, southern Magwe, and western Minbu. In the district townships of these dry-zone districts, or where the soil is not good, it is more than questionable if the Cutch ever attains anything like the large girth which would make the fixing of a three feet girth a reasonable minimum below which the felling of green

trees should be prohibited. From observation it has been noticed that in many tracts the trees dry and die without reaching that girth. In fact it is open to considerable doubt if the cutch generally occurring there may not be another species than the true *Acacia Catechu*,—a view which is corroborated to a certain extent by Kurz, at page 422, Volume 1, of his "Forest Flora of British Burma."

With a view to establish comparisons as to rate of growth of cutch, the following data have recently been collected :—

District.	Character of Forest.	Quality of wood.	No. of Annual Rings.	Girth.	Diameter of heart wood.	Average annual girth in amount.
		Dry Zone.				
Yamethen...	Dry open forest	Lighter than Pyinmana	8	0' 9½"	...	1'2 "
	,, ...	Ditto ...	15	0'11¼"	...	0'75"
	,, ...	Ditto ...	rotten.	3' 9 "	...	(?)
	,, ...	Ditto ...	15	3' 3 "	...	2' 6"
Meiktila ..	Scrub jungle much cut over for Ry. fuel in 1887 ...	Medium in colour ...	7	1' 1 "	...	1' 9"
		Light in colour ...	5	1' 2½"	1¼"	2' 9"
		Ditto ...	5	1' 1 "	1 "	2' 6"
		Ditto ...	5	1' 1½"	1¼"	2' 6"
	,, ...	Medium in colour ...	9	2' 2½"	5¾"	3' 0"
	,, ...					
	,, ...					
	,, ...					
		Intermediate zone.				
Meiktila ...	Scrub jungle near base of hills on good soil ..	Light in colour, ... Rings very indistinct.	15(?)	2' 7 "	7½"	2' 0"
			19(?)	2'10 "	7½"	1' 8"
Yamethen...	Mixed forest, verging on moist zone ...	Resembling specimens from South Pyinmana ...	15	3' 7 "	...	2' 8"
		Moist zone.				4' 0"
Pyinmana...	Lower dry forest	Lighter than specimen from Minbu ...	7	2' 4 "	...	3' 3"
			9	2' 6½"	...	3' 7"
	Mostly coppice	......	7	2' 2 "	...	3' 6"
	Growth in pônzôs	......	9	2' 9 "	...	
	Lower mixed forest ...	Ditto ...	11	3' 2 "	...	3' 4"
	Lower (different locality) ...	Ditto ...	12	3' 3 "	8 "	3' 2"
			9	3' 4 "	9½"	4' 4"
	Savannah forest.	Ditto ...	9	2' 4 "	...	3' 1"
			9	2' 8 "	..	3' 5"
			11	3' 2 "	...	3' 2"
Minbu ...	Not stated ...	Heart wood dark, almost chocolate coloured and full of "*ugyi*" Annual rings very indefinite ...	11(?)	2' 7 "	6½"	
			14(?)	3' 2½"	8 "	

Imperfect and incomplete as these hastily collected data are, they show that, on the whole, growth in the moister tracts is considerably quicker than in the dry zone, and that the heartwood in the former appears richer in cutch than in the latter. In the former, a girth of 3 feet is attained after about 10 to 12 years with a diameter of about 8 inches of heartwood.

The Pyinmana specimens shew somewhat quicker growth but not such rich heartwood or abundance of '*u-gyi*' (cutch cells) as those from Minbu. This is probably due to the fact that the taungya system of cultivation is more generally preserved in the former, and that the bulk of the existing supplies of the timber is obtained from coppice shoots. Cutch is decidedly light-loving, and when coppice shoots get the full enjoyment of light, air and sunshine in pônzôs (old clearings) they grow with great rapidity; seed too then gets a chance of germinating on the clearance of the over-shadowing canopy.

This fact of the exiting supply of cutch wood being located in tracts where taungya cultivation is general in the Pyinmana and Yamèthen districts, would point to the advisability of reserving cutch tracts. This, however, the Deputy Commissioner does not approve of, as the land is all practically of culturable quality, in proximity to the railway line, and likely to be required for permanent agricultural occupation at no very distant date. Even the Forest officer writes that he sees "little possibility of having the greater part included within reserved forests." In the Pyinmana *and Yamèthen Districts there are from 30 to 36 thugyiships (revenue* circles) in which cutch tracts occur, and if it were only possible to open 3 of these each year for cutch boiling and taungya cultivation simultaneously, so as to work with a 10-12 years' rotation, we should always be certain of a good supply of cutch. The trees coppices up to 3 feet girth, although it is questionable if they can reproduce themselves from the stool beyond that age, and seed is shed from about the 5th to the 6th year. As, however, the villages, whose inhabitants adopt taungya cultivation partly, are permanent no such system can be introduced. At present, thousands of saplings and young trees are killed year after year by the firing of the yas even when the cutch is not felled along with the rest of the jungle at the time of clearing.

On the Magwè side, the cutch tracts have been overworked to such an extent that all cutch boiling has this year been stopped to allow the localities to recover themselves. On the Pyinmana and Yamèthen side, the tracts have also been much overworked during the last three or four years, but in order to alleviate the distress that is certainly wide-spread among the forest classes this year, this over-working is being continued (within certain limits) this year also,—only however for the benefit of actual residents. Recent valuation surveys in the Pyinmana district shew only the following stock :—

Valuation Surveys.		No. of cutch trees.			Average No.
No. held.	Area counted out in Acres.	3′ in girth and above.	Under 3′ girth.	Total.	Per Acre.
45	1,814	146	5,977	6,123	3·37

A great deal of the cutch produced in the Meiktila and Mandalay districts is 'sha byāw' (soft cutch) and not 'sha-mā' (firm cutch) It is sent to Rangoon, consigned to Chinese firms, in its semi-viscous condition, looking like thickened crude earth oil, and there re-boiled along with other hard cutch—or probably with *than* (Terminalia Oliveri) bark, or bark extracts if the truth were known.

The following data relative to the outturn of cutch have been collected for me by Mr. Copeland, D. C. F., Pyinmana :—

1. A prepared log, *i.e.*, freed from bark and sapwood, of $8'3'' \times 1'10\frac{1}{8}''$ yielded chips filling $8\frac{1}{4}$ chatties tightly packed.

2. Twenty chatties of cutch chips, decocted twice, as usual, yielded in 24 hours 5 viss 70 tolas of viscid cutch, of quality below medium and selling in Pyinmana at Rs. 32 per 100 viss.

3. Transport of cutch from camp to Pyinmana is from 8 annas to Rs. 1 per 100 viss.

4. The preparation of the cutch log took 1 man $\frac{1}{2}$ an hour, and the chipping $3\frac{1}{2}$ hours. It is considered a fair day's work for a man to prepare and chip enough wood to keep one cauldron going. His wages may be reckoned at 8 annas per diem.

5. The cost of delivering in camp 100 logs similar to that in No. 1, is Rs. 15.

6. *Additional help is required for tending the* cauldron, generally the wife of the chipper, who may be reckoned at 4 annas per diem.

Deductions from the above data are :—

1. Each cauldron uses up 5·34 cub. ft. (true measurement in short sections) of heartwood per diem and produces 5·70 viss of cutch.

2. The cost of production of 5·70 viss of cutch is :—

Delivering timber	Rs.	0	6	0
Chipping heartwood	,,	0	8	0
Tending cauldron	,,	0	4	0
Packing in cases of baskets ...	,,	0	1	0
Total	Rs.	1	3	0

3. The market value of the 5·70 viss of cutch at Pyinmana, at Rs 32 per 100 viss, but deducting Rs. 1 for transport from camp, is Rs. $5{\cdot}7 \times 31 \div 100 =$ Rs. 1-12-3.

4. The nett profit per diem after allowing wages to the worker, his wife, &c., amount to Rs. 0-9-3, or Rs. 15-0-6 per month of 26 working days.

5. The amount of cutch timber consumed in a year of 200 working days would be 5·34 cub. ft. × 200 = 21·36 tons of heartwood or of *growing timber = 50 tons probably. In a year of 270* days, 5·34 cub. ft. × 270 = 28·84 tons of heartwood or of growing timber = 66 tons probably. Under the circumstances described, it seems the best thing that Catechu should be declared a reserved tree, and that licenses for the preparation of cutch should be issued subject to the following conditions :—

(i) No license to be issued for more than one cauldron, and no individual to obtain more than one license.

(ii) Licenses only to be issued to villagers resident in the township where the cutch boiling is to take place.

(iii) No license to be issued to any one who has a license for the preparation of bark extracts.

(iv) License fee to be Rs 5 p. m. prepaid monthly.

(v) *No green catechu trees to be cut less than 3 ft. in girth at* breast height, except in such districts, and only in such townships of said districts, as may be sanctioned from time to time by the Conservator of Forests.

(vi) Contravention of rules at any camp to involve forfeiture of all the cutch boiling licenses at said camp.

Hitherto, *in a great many instances, licenses have been taken* out by men from lower Burma who simply employed the coolies on job work paying them abont Rs. 4 per 100 viss of cutch and giving them food-supplies during time of cutch production. For this reason a monthly prepayment fee is proposed, instead of a lump sum, thereby probably enabling the villagers to have licenses independently of brokers and middlemen.

J. N.

A Japanese Timber Slide.

When in Scotland in 1884, I visited the Edinburgh Forestry exhibition and among the many interesting exhibits from Japan, noticed a model of a timber slide, a few notes on which may not be uninteresting even so late as now.

wall, against which the timber strikes violently on turning and is prevented from moving out of the proper course. In this way

The model showed the way in which timber is transported out of deep mountain forests. When the trees of the genus *Pinus* are felled and dressed into baulks they are collected is one common place, which is called 'Seridashi.' From this place they are to be transported out by means of an elevated floor known as 'Sade.' This is constructed by the side of a declivity where the transport becomes very difficult on account of the road being very narrow and uneven. In the first place, a kind of gate is built with two large pieces of timber which cross each other at the top and against this gate timbers are inclined forming a sort of fence called 'Tome' meaning "timber obstructor." One day this gate is closed to collect timbers and on the next it is opened to send them to the Sade, so that the gate is shut and opened on alternate days. Just outside the Tome or gate, timbers are horizontally arranged for 6 or 8 yards, called 'shura' and this is continued as far as the Sade proper. For the construction of the 'Sade' a support called 'Toriidai' is first built of two pillars to which a horizontal beam called 'Udegi' 2 to 4 yards long is fastened. Such supports are built at the distance of 6 to 8 yards from one another, their heights being altered to form the desired inclination. Then a long piece of wood called 'Sao' is stretched from one Uuegi of one support to that of another on both its sides and the distance between two Sao is about five feet. Across the Sao trough shaped timbers called 'Tonkase' are fastened; and parallel with them, beams of three to four inches diameter are arranged at the distance of one foot from each other. These latter are called 'Yorai' and twigs of 'Hinoki' *(Thuya dolabrata)* are woven across them, the ends of the twigs always projecting below, so as to leave the upper surface smooth. These are then firmly fastened by timbers fixed on both sides called 'Kategi.' The space between two Kategi is about three feet, and this forms a floor on which the timber slides down. Such an arrangement is known as 'Tamba Sade.' There is another called 'Nora Sade' in which the sliding surface consists of 'Sawara' (*Thuya pisifera*) boards one foot four inches broad and 4 feet five inches thick instead of net-work. In both cases Kateji and Tonkase are supported by pillars to make than firm. 'Tamba' Sade is constructed at those places where the inclination is not very great, while the 'Nora' is better fitted for greater inclinations. For bending the course of the sliding floor, an arrangement known as 'Usu' is provided. This consists of a sort of elastic wall built of the bark of the *Thuya dolabrata* at some distance from the Sade and in front of this wall a pale inclined at an angle of about 45 called 'Suribo' is provided. Now a piece of timber on coming to the extremity of the sliding floor dashes against the wall or usu, but one of its ends rests on the inclined pole or Suribo, so that this end immediately slides down the pole and enters on a second floor. There is another inclined pole called 'Koshinchibo' by the side of the

4 to 5,000 pieces of timber can be transported in a day. Sometimes, however, timbers get stopped on the way, hence labourers are distributed here and there to manage them. There are also two or three persons stationed at high places, who watch how the timbers get down and in case they slide down too fast or if there happens to be any obstacle, they report the matter to the Tome to send out wood more slowly or to stop entirely. In case of Nora Sade, the velocity of the sliding timbers is great and they often jump out of the proper course, hence, to obviate this inconvenience, an arrangement called 'Noren' is provided, which is made by hanging timbers from a cross-bar built over the floor, so that their ends rest on it, and the pieces on sliding down must creep under them: thus the velocity gets much slackened, and their falling off is prevented. If, on account of the inclination of Sade being too great, the timbers slide down too fast the floor is covered with fine earth which, causing friction, slackens the speed—if the contrary be the case, water is sprinkled on the surface to make the timbers slide quicker. The construction of Sade requires a great deal of material as well as of labour, so in places where there is a stream that can be made use of, advantage is taken of it even for a short distance and the mode of transport under such circumstances, goes by the name of 'Shuradashi.' For constructing it, timbers are first piled in a slightly concave form at the extremity of the sliding floor. When timbers that are sent down are collected all along the sides of the stream, other timbers are arranged longitudinally, and to make the water as as deep as possible, a weir is built at the lowest part by piling up timbers in many layers called "Segi." This consists really of two parts, the lower and the upper, called respectively 'Takasegi' and 'Uwasegi.' The lower one is made by piling up timbers horizontally and the Uwasegi is constructed by heaping timber in a slanting position. All the crevices through which water flows are carefully stopped by inserting weeds, tufts of moss or leaves of plants, and by this means the shura is watered as far as possible, and timbers sent down and when they come to the segi or weir they are transferred to the next shura by men. All the timbers used for the construction of the several parts are eventually themselves brought out, commencing with those at the uppermost place. Sade and Shura are most economically used for the transport of about 30,000 timbers, because the expenses of construction and the number of men required are the same for as for a less quantity of the timber. But if the number of the pieces of the timber to be dealt with comes to as many as 40,000 or 50,000, many things get mixed up and cannot be managed properly. The whole construction requires a most experienced person to manage it, otherwise, not only is much time spent in transport but many parts happen to break and during the time of mending, labourers must be paid without any work to do, which causes a great loss.

R. C. W.

Rules for obtaining Photographic Records of selected Forest areas.

In order to illustrate the results attending the protection of forests from indiscriminate cutting, lopping, grazing, and especially from fire, as well as to indicate the progress of plantations or other reboisement works, it has been decided to start a system of photographic records for selected forest areas. Photographs of these areas will be taken periodically, and it is anticipated that the series of views thus obtained will be a most valuable aid in showing the results which may be and are obtained from forest protection. Forest officers are frequently met with the remark that in specified localities forest protection can yield no material or beneficial results ; and occasionally the pendulum of official opinion and action swings backwards because no more convincing proofs of progress can be adduced than written records, often those of foresters who have retired, and evidence of this kind is not always accepted.

It is desirable, inorder to obtain the best results, that, as a rule, photographs should be taken (1) of areas at the time they are first protected from fire or closed to grazing &c. ; and (2) of areas which have been protected for some time, and which it is decided to throw open again to grazing, &c. To carry out this purpose, two cameras, together with all materials necessary for taking photographs in camp, will be supplied by Government, and the following rules are laid down for the use of the cameras and for guidance in taking photographs :—

I. One of the cameras will be under the charge of the Director of the Imperial Forest School, and the other under the charge of the Superintendent of Forest Surveys. Both cameras will be available for use in any part of the Bengal Presidency, and Conservators desirous of having a photograph taken of any special locality should apply in the first instance to the Inspector-General of Forests, stating the object of the proposed photographic record, as well as the name and the qualifications in photography of the officers whom it is proposed to entrust with the camera. The Inspector-General of Forests, if he approves of the

application, will then arrange, either with the Director of the Forest School or with the Superintendent of Forest Surveys, for the supply of one of the cameras.

II. The Director of the Forest School will determine, as regards the camera under his charge, what photographs should be taken for purposes of instruction at the School, and by which of the School officers the record will be made. If the camera is sent out with a party of the School students under the Deputy Director or an Instructor, the officer in charge of the party will, in communication with the local Divisional Forest Officer, select for operations such places as it may be considered desirable to photograph, reporting what he has done to the Director.

III. Similarly, the Superintendent of Forest Surveys will determine how, and by which of the officers serving under him the camera in his charge is to be employed.

IV. In order to ensure that for each locality of which a record is made, the same field of view may be obtained, the spot at which the camera was originally set up should be durably marked by a permanent benchmark, or, if this is impossible, by a record of the exact distance of the spot from each of two permanent bench-marks. For purposes of comparison, the camera should always be set up for each locality considered at the same height from the ground, and each successive photograph of the same series should embrace the same field of view.

V. The interval between the taking of two successive photographs of the same locality will ordinarily be five years; otherwise the interval will be that recommended by the first operator and approved by the local Conservator. All successive photographs must be taken at the same season, and as nearly as can be on the same date.

VI. In order to better illustrate the rate of growth of vegetation, arrangements should be made either (*a*) for a graduated levelling staff, or pole with divisions and figures in feet clearly marked upon it, to be placed in a conspicuous position in the fore-ground on a previously constructed bench-mark, or on a site definitely fixed by angle and distance measurements from the camera bench-mark, so that it may be possible, with the aid of a magnifying glass, to read the figures on the photograph; or (*b*) for a small group of the natives of the locality to be stationed at a similar place in the fore-ground, with a few others, if desired, scattered at various other points in the field of view.

VII. A register of particulars will be maintained by the Divisional Officer (copy being kept in the offices of the

Director of the Forest School and the Superintendent of Forest Surveys respectively), in which will be recorded in suitable columns—

(*a*) the number of the negative and size of plate ;
(*b*) the date and hour of the day ;
(*c*) the position of the bench-mark or marks as required by Rule IV ;
(*d*) the height of the camera-stand from the ground;
(*e*) the needle bearing of the edge of the camera ;
(*f*) the position of the bench-mark of the measurement staff or of the group referred to in Rule VI ;
(*g*) the general state of weather at the time, especially as regards cloud [the size of 'stop' used should be noted] ;
(*h*) a short description of the locality and its vegetation ;
(*i*) the special reasons for which the photographs were taken, with any additional information, such as the dates of closing of the tract to fire, grazing, &c. ;
(*j*) the period recommended as best to be adopted between each two successive photographs ;
(*k*) the name of the operator.

A special page or pages should be set apart for each view taken, so as to allow of easy comparison between successive entries. A copy of the entry should be deposited in the office of the Conservator of Forests of the Circle in which the place is situated, so as to provide against the possible loss of the register.

VIII. *The negatives taken should all be numbered serially in* agreement with the numbers given in the register, and should then be sent to the Photographic Office of the Survey of India Department, Calcutta, where they will be stored, and from whence prints will be obtainable on regular indents. A copy of each photograph taken should invariably be supplied by the Conservator, &c., as the case may be, to the undermentioned authorities :—

(i) Inspector General of Forests.
(ii) Director of the Forest School.
(iii) Superintendent of Forert Surveys.
(iv) Conservator of the Province or Circle.
(v) Divisional Forest Officer.

IX. When the cameras are used for private purposes, such as photographing camps or other views not necessary for the requirements of the Forest Department, Government plates and other materials must not be used for negatives or for the printing of photographs.

A New Experience.

The forests we set out to visit in November were remarkable for two reasons, firstly for the prevalence of jungle fever and secondly for the presence of Wild Buffalo. Fact number one did not interest or surprise us, whereas fact number two filled our breasts with much longing and a little hope, and we started armed to the teeth, with quinine for the fever and with a heavy D. B. ·577 express for the buffalo. After days of wandering, during which we were sometimes cheered by the sight of buffalo tracks, sometimes depressed by the paucity of game of any kind, and always regaled by the ready native with wonderful tales of what had happened in years gone by, how the Collector Sahib had fled for his life from a wounded Cow; how the Assistant Engineer had been treed by a furious bull; and how the Opium Wala had been floored by an outraged calf; we arrived somewhat weary and yet full of ardour, on the borders of Nipal and pitched our camp in an open plain dreary enough in itself but rendered beautiful by the magnificent view of the snowy ranges which filled in the northern horizon. We had given up all hopes of buffalo, a chital stag would have satisfied us, we were even keen on the domestic antelope ; so much so that seeing several bucks not far from the tents, we started in the evening to stalk one if possible. The better half of us remained on the pad elephant to watch the sport from a distance and was rejoined later on when a buck had been missed and the calling of chital and the rumbling roar of a leopard recalled us to the possibility of better sport in the neighbouring Sal Forests. The sun was already setting when we entered a narrow grassy glade and stole quietly along amidst the lengthening evening shadows, disturbing, as we went, a couple of hinds and one small stag not fit to shoot. We were tired after a long rough march, prolonged by losing our way and having to walk miles through rough tree jungle ; and the calm coolness of the autumn evening was fully appreciated as we indolently sat on the pad elephant. Suddenly, it seemed as if out of the ground, arose a mighty form which in two lazy bounds reached the edge of the forest and turning, faced us with lowered head and ready horns. And the heavy rifle was miles away in Camp ! The utter futility of attempting to stop that bull with a hollow fronted bullet was our first thought ; the second whether he would charge and scatter us to the winds if we annoyed him ; the third, that if we let pass this chance of bagging a solitary bull

we should never in all our lives have another ! We moved the elephant so as to have something softer than a forehead to aim at but the huge head turning slowly so as to keep a front to the enemy, we steadied the rifle for a second and pressed the trigger ! The smoke rolled slowly down the little glade. and as it lifted we saw the buffalo lying dead where he had stood menacingly one instant before. Approaching cautiously, we needlessly expended a couple more cartridges without producing the slightest effect and then surveyed our prize. The first bullet had struck in the centre of the forehead and exploded in the brain. He was a full grown bull in the prime of life ; so far, our knowledge of buffaloes informed us ; but whether exceptionally large we could not tell. At any rate, he was over 11 feet long from the nose to the tip of the tail, and his horns measured 8 feet 4 inches from tip to tip along the outside curve and across the forehead. He was big enough for us, we wanted him no larger ! That night, a noisy procession crossed the level plain under the light of the young moon and through the evening mists. It was preceded by a hurricane lantern, and twenty willing pairs of arms urged the timid oxen to draw the cart heavily laden with the lone monarch of the jungles who fears no foe save man and does not hesitate to make it unpleasant even for him when vexed. Pathos is impossible when one of the last representatives of the virgin forest is lighted to his grave with oil from Batoum and a lantern from America ! But the rifle which had slain him was examined by indigenous experts and pronounced to be hard hitting and when the ever ready sycophant opined that the "sahib's" power was such that one bullet sufficed to kill an elephant, he was silenced by the remark, greeted with much applause, that the bull had died of the shock and surprise of being "Shikared" by the "Mem Sahib."

O. C.

Notes on the Otter.

In these days of fish preservation societies, when much trouble is taken by individuals to improve the sport in certain Indian waters, attention may well be directed to the injury done to the fishing by otters and the means available for diminishing the numbers of these pests. Being a keen fisherman myself, I have, how often, been grieved and infuriated to find, on arrival at well-known pools and reaches, that the fish have been either cleared out altogether or scared away, whilst the numerous tracks on the sandy banks and the remains of many good fish lying about, explained what had been taking place during the previous night. The pre-wnce of a few otters on a long stretch of water is bad enough, but sehen it comes to schools of ten or twelve hunting in line, either the

otters must be removed or fishing must cease. In the *Forst und Jagd Zeitung* for October there are some interesting notes on the difficulties caused in the waters of the Fishing Society on the Neckar at Tübingen. The attempt to introduce new and better varieties of fish into these waters was completely frustrated by the otters, who shewed a marked predilection for new and superior feeding ; and the members of the Society were driven to despair until a Godsend, in the shape of a young man with a knowledge of traps, arrived on the scene, who in the course of some six months on some four miles of water, put an end to twelve otters, one badger and a fox. The Fishing Society at Tübingen is now once more happy, having completely circumvented their foes and desire to aid other societies in similar circumstances. It has been calculated that the annual feed of one otter amounts yearly to three-hundred to five hundred pounds of fish, besides what the brute wastes, which would amount to as much more. That this is a moderate estimate, is proved by the fact that a twelve lb. otter caught at Tübingen contained four lbs. of fish ; the largest capture, weighing 21 lbs.. would probably have taken six to seven lbs. of fish at a meal ! With regard to exterminating otters, shooting has been found to be quite useless ; posioning is impossible, as the otter will not touch dead fish ; but success attends the laying of spring traps in the run just at the water's edge but not in the water. The Indian otter is more migratory than the European animal but still there are times and places where a stay of some days is made, and it seems to me that it would be quite possible to train a native to skilfully lay traps in the stretch of water in his charge, and that a liberal payment per head would soon result in a considerable diminution of these pests. The trap used by the Tübingen Society is labelled 126 in the Catalogue of Messrs. F. Grell and Company at Heynau, Germany. Form another quarter, in the same periodical, comes a story of the utility of the otter, which must tend to discourage the ardent fisherman. Mr. Oberförster Haug having procured two otter cubs of a few hours old, still with unopened eyes, and wishing to send them to the Stuttgart museum, proceeded to drown the poor wretches and after seven minutes immersion in water, packed them up tightly in newspaper and despatched them by parcel post. He received some days after a letter from the Curator saying that only one had arrived safely, the other having been killed when stamping the parcel ; the survivor at once took to a bottle and was thriving vigorously when he wrote !

O. C.

Important tests of Australian woods.

The following important tests of Australian and other woods may be found useful to many of our readers. They were made in the presence of Mr. Thomas Laslett, timber inspector to the Admiralty, and have appeared in the *Shipping World*.

TRANSVERSE EXPERIMENTS.

Name of Wood.	Weight per Cubic Foot.	Specific Gravity.	Transverse Strength per Square Inch.	Average Tensile Experiments. Dimensions of Each Piece.	Average Tensile Experiments. Weight the Piece broke with.	Average Tensile Experiments. Direct Cohesion on One Square Inch.	Vertical or Crushing Strain on Cubes of 2 in.	Number of Years Assigned by English Lloyd's for Shipbuilding Purposes
	Lb.		Value of s.	In :	Lb. per sq. in.	Lb. per sq. in	Tons. per sq. in.	Years.
Indian teak ...	49·47	807	2203	2 –2 × 30	13,207	3301	2·838	14
English oak ...	58	886	2117	2–2 × 30	30.287	7571	3·411	9
Jarrah ...	63·12	1000	1800	2–2 × 30	11,760	2940	3·198	12
Karri ...	61·31	981	2264	2 × 2 × 30	28,280	7070	5·140	12

(*Timber Trades Journal.*)

White-ants and Mango Trees.

If the bark of the trees is attacked by white ants, it must be first scraped off at all parts where the animals have made tunnels, and painted with kerosine. Let the ground be dug between the trees as deeply as necessary, the soil turned over and watered with phenyl, if procurable ; if not, with kerosene and water. In Ceylon, a decoction of the leaves of Mauritius hemp is used for expelling white-ants, but I fear, a correspondent writes, you have got into too bad a state for that to be efficacious. It has the advantage of being, of course, quite harmless to any trees. In using the phenyl, put some in a pail and add water till it is of the colour and consis-*tency of good milk. Every plantation should keep phenyl. It is* perfectly safe with foliage ; carbolic acid and kerosene are not. It is exceedingly good for mealy bug. Corrosive sublimate and Paris green will both destroy white ants ; dissolve in water and pour into the holes. But be careful not to poison the trees by putting these poisons too close to the roots. Corrosive snblimate is very popular here, being used dry. The planters have told me that one white-ant eats a grain, dies, and is eaten in turn by another who dies and so on till the nest is exterminated. I cannot quite credit this, but the poison has a very strong effect on white-*ants. Of course care should be taken in dealing with corrosive* sublimate in bulk, as it is an exceedingly dangerous poison. After you have well poisoned the white-ants, remember to manure the

trees well, so that they can have strength to recover. If it is possible to flood the plantation for a few days, the ants would have to retire, but this is rarely possible here at least. I do not think it would hurt the trees, as I have here splendid old trees growing in water. I should like to know the results of these suggestions should you find time to inform me, as I am collecting together all kinds of notes on destructive insects and methods of destruction.—(*Indian Agriculturist.*)

Bulgarian Forestry.

At the National Bulgarian Exhibition at Philippopolis there is a pavilion of forestry, tastefully constructed of logwood, and containing various specimens of woodwork and blocks cut from the stems of the enormous trees which still flourish in the remote primeval woodlands of Rhodope and the Balkans. This is a reminder of the ruthless destruction of Bulgarian forests which went on in Turkish time, and still continues to some extent notwithstanding the efforts of the Bulgarian Government to cheek it. An interesting feature in this pavilion is a portion of one of the wooden tramways which are used for bringing timber down the steep sides of the mountains. The stems of young trees supply the place of rails; the felled timber is laid on wooden trollies with small wooden wheels, and descends the mountain at a rapid pace in charge of two or three men, who find a precarious standing place on a peg which projects over the wheels, and check the pace by working a brake with the foot.—(*Timber Trades Journal.*)

The teak trade of Chiengmai.

The Trade Report for 1891 of this important dependency of Siam, by Mr. Stringer, British Acting Vice-Consul at Chiengmai, should be of considerable interest to the local Government, says the *Rangoon Times*, which has secured an advance copy of it. Much is not known of Chiengmai in Burma, and Moulmein is the only town which has any trade relations with the Laos States, excepting the semi-independent Shan States under British protection, so the report we propose to shortly review here, contains information interesting as well to the general public as to those connected with trade and commerce in Burma. This is the second report of its kind which has been issued, we believe, the first report being for the year 1890.

At present Chiengmai is what may be called a timber country. Its teak is its chief, almost its only, source of wealth, and it is pity to know, as the writer of the report tells us, that the teak forests are being fast ruined by the neglect of the rules of forestry by those

of British traders, but as far as we can judge, those connected with the timber trade seem more eager to develop the trade with Bangkok than with Moulmein. During the coming season, it is proposed, as an experiment, to send squared logs instead of logs in the rough, as is being done now, from Chiengmai to Bangkok, as less duty will have to be paid, and the weight to be dragged through the water will be less. Before the logs, intended for delivery at Bangkok, arrive at Chainat, the duty-station on the Menam, they are brought down several branches of the main river, chief of which are the Me Wang, and the Me Yom which we have mentioned. During 1891 these rivers bore 9,500 logs down to the duty-station, against 30,000 the previous year, and upwards of 60,000 during each of the years 1888 and 1889. It is expected that during the coming season, with ordinarily good waters, the delivery from the Me Wang and Me Ping alone will be 30,000 logs, and which high floods 50,000 logs. During 1891, the *Salween* brought 13,873 logs down to Moulmein which was 18,244 logs less than during the previous year. The scarcity of water in the rivers, the result of the scarcity of rice from drought, which appears to have been as acute in Chiengmai as it was in parts of Upper Burma, contributed towards the depression of the teak trade during 1891.

The statistics collected by the British Acting Vice-Consul, considering the informal way in which Siamese officials do things, cannot be expected to be scrupulously correct, but they are correct enough to give one a fair idea of the conditions of this trade. With what facts we have before us, it appears quite certain that if a very material alteration in the forest administration of the forest areas of Chiengmai is not made soon, the teak trade of this province will, in a very few years, be a thing of the past, with the consequent result that Chiengmai will be greatly impoverished and become denuded of many of its inhabitants, who will have to seek occupation in the surrounding districts. The chief source of wealth of the Laos States is their teak, and when the forests become depleted of their teak, the result we have stated must follow.—(*Timber Trades Journal.*)

Podophyllum Emodi.

Mr. D. Hooper, Government *Quinologist, Madras*, *writes* to me as follows :—

Since writing to you about the Podophyllum root, a paper has been read on the chemistry of the resin at the British Pharmaceutical Conference at Edinhurgh. Mr. Umney, the author, states that he has fouud less of the supposed active principle—podophyllotoxin—than there is in the root of the American P. Peltatum. The

paper will appear in full in the Year Book of Pharmacy. Mr. Umney says in conclusion that the Indian drug should be used as an alternative source for the preparation of the official resin in the British Pharmacopœia. I am not satisfied with this result, and am writing to England saying that no conclusion should be drawn until a complete physiological examination has been made of the resin.

INDIAN MUSEUM,
CALCUTTA.

EDGAR THURSTON.

Notes on the State Forest of Lyons (Normandy).

(*Prepared by Monsieur Le Père, Inspecteur des Forêts, Lyons. Translated into English by Mr. W. R. Fisher, Assistant Professor of Forestry, Coopers Hill College.*)

Area and locality.—The State forest of Lyons contains an area of 26,211 acres.

It is situated 20 miles from Rouen, in the two Departments of the Eure and the Lower Seine, and extends over a tract of country bordered as follows:—North, by the plain of Argueil; east, by the valley of Epte; south, by the plains of Norman Vexin; south-west, west, and north-west, the valleys of Fouillebrocque, of the Lieure, and of Andelle.

This tract, owing to its configuration, as well as to the varieties of its soil, affords characteristic examples of the various aspects of Normandy with its forests, meadows, and arable lands.

The Department boundary line divides the forest into two nearly equal portions—in the north, the blocks of Fleury and Gourvinay, with an area of about 11,293 acres; and in the south, the blocks of Fleury sur Andelle, Lyons, and Etrépagny, with an area of 14,918 acres.

A polygon surrounding the forest would be no less than 42 miles in perimeter, its greatest breadth from east to west, as well as from north to south, being about 14 miles.

The forest is demarcated by boundary pillars along a total length of 203 miles. The little town of Lyons is situated in the valley of the Lieure, in a nearly central position as regards the forest, which descends to the banks of the Andelle in the south-west from the elevated plateau of Beauvoir in the north-east. The altitude of the forest above sea level varies from 164 to 722 feet.

More than half the forest is situated on undulating ground, and it is almost cut in half from north-east to south-west by the fairly deep valley of the Lieure and the depressions leading into it. The depressions of Fouillebrocque and of St. Catherine's springs subdivide it in the south, parallel to the valley of the Lieure.

The River Lieure, which springs up in the forest at Holly fountain, bounds its eastern blocks to the south in a pretty deep valley, into which several depressions, coming down from the forest, lead.

Climate.—The forest of Lyons almost everywhere shows a remarkable vigour of growth due to the mild and moist climate of a region not far removed from the sea.

Soil.—The soil is formed by the weathering of secondary and tertiary geological strata; the former is only exposed in the lower part of the valleys, and belongs to the upper cretaceous formation, consisting of nearly horizontal beds of white chalk, with numerous layers of flints. The tertiary strata are much less regular and form

the subsoil over the greater portion of the forest area. They contain many different mineralogical elements—flints, gravel, quartz, sand, sandstone, dry sandy marls, plastic clay containing iron, &c. The latter is found in the depressions of the silicious strata, consisting of sand, sandstone, and rolled flints. Such a deposit occurs between Lyons and Gisors. The strata near Hogues are remarkable for a mass of ochraceous sand, puddingstone, and massive sandstone. Everywhere on the surface of the Lyons block, sandstone and flints abound. Near Mont-Roti, the strata contain bright variegated quartz. From several places sand, clay, and sandstone are exported, and almost everywhere the flints are utilized for road metalling.

The soil formed from very variable proportions of the débris of those different elements varies considerably over small areas, sometimes attaining a depth of 13 feet, at others being reduced to a superficial coating of hardly eight inches.

The amount of moisture in the soil varies according to its composition and gradient, the soil being generally moist and permeable. Marshy ground only occurs in patches, 7·4 acres at Hotel-à-Dieu, and has almost disappeared owing to drainage works executed about 15 years ago; but ponds are not uncommon, and have served in the nomenclature of several compartments. One of them has given its name to the celebrated abbey of Mortemer, the picturesque ruins of which still exist. These ponds appear to have been excavated near old dwellings, traces of which are still visible.

About one fifth of the forest area may be classed with neighbouring first-class arable lands, one fifth as second class, two fifths as third class, and the remaining one fifth as fourth class. The estimated value of the forest land formerly placed at 16*l*. to 40*l*. per acre, would now be too high.

Species.—The forest of Lyons is pre-eminently a beech forest. This species occupies more than two-thirds of the area; it attains here very fine dimensions at a comparatively low age. One frequently sees beeches only 100 to 120 years old with a height of 131 feet and a diameter of 20 to 28 inches, measured at 3·3 inches from the ground.

The wood of Castelier, 150 to 230 years old, contains more than 14,291 cubic feet per acre, the trees there having a mean height of 148 feet (*vide* Appendix).

The hornbeam and the oak are mixed unequally with the beech, the proportion of the oak being less than one fifth of the stock. The wild cherry, ash, birch, aspen, and sallow only appear occasionally, the two latter merely in the young thickets, before cleanings have been made.

A few small woods of Scotch pine may also be noted, situated on soils at present too poor for broad-leaved species.

The sycamore and elm have been introduced into some old blanks.

Nature of the stock, its age, and density of growth.—Most of the forest is composed of woods with a proper succession of ages

up to 120 years. Some few woods are 150 to 160 years old. Nearly everywhere in the regeneration fellings the presence of a certain number of old standards compensates for the relatively low age of the rest of the crop. On the whole, middle-aged trees somewhat preponderate.

Few other forests in France are so completely stocked. Blanks are almost entirely unknown, and plantations are only required to complete the natural regeneration, at the extremely rare places where it is delayed beyond the usual time. These plantations are generally made to introduce oak into pure beech woods.

From time immemorial, the forest of Lyons has been treated according to the regular high forest system, and it is due to this treatment that its woods are so exceptionally well stocked.

Working Plan of the Forest.

Method of working.—The forest of Lyons is treated as high forest by the shelter-wood compartment system (*Méthode de réensemencement naturel et des éclaircies*),

The working plan sanctioned in 1862, but actually applied since 1856, divides the forest into 15 working sections (*séries*), with a rotation of 150 years for each, which is subdivided into six periods of 25 years each for working sections 1 to 12 and 14. The area to be worked in each period is termed a periodic block.

At the end of the first period, 1881, the revision of the working plan was carried out for these 13 sections, the annual yield of the principal fellings being calculated for the second period. The allocation of the improvement fellings (thinnings and cleanings) was at the same time fixed for the second period, each compartment to be gone over twice during the period.

In the 13th and 15th working sections the rotation was subdivided into five periods of 30 years each, and the first period expired in 1885. The revision of the working plan for these sections took place in 1886, and the allocation of the improvement fellings made; they will go over the ground three times during each period of 30 years. The forest, therefore, for 13 working circles is in the eleventh year of the second period, and for the two others in the seventh year of the second period (in 1892).

Principal fellings.—Three regeneration fellings (seeding, secondary, and final fellings) are carried out, as, although natural regeneration is certain, it is not rapid enough for the seed-bearers to be removed in one felling, and they are also useful in affording protection to the young crop.

At present, in the middle of the second period, seeding fellings are most frequent.

Secondary fellings have, nevertheless, been made in some of the working sections, in the first seeding fellings of the second periodic blocks. Certain portions of these fellings, where the regeneration has been very favourable, are already partially under the final felling.

Improvement fellings.—The improvement fellings are regulated by area. These fellings, during each period, go over all the periodic blocks which are not under regeneration ; that is to say, for the second period, the 1st, 3rd, 4th, 5th, and 6th periodic blocks, except in the 13th and 15th sections, which have only five periodic blocks.

Accordingly, as these fellings must recur twice or thrice in each period, the total area is divided by one half or by one third the number of years in the period, and thus the area of the annual improvement fellings is calculated.

The subdivision of the periodic blocks into areas for each annual thinning has been marked out on the ground, thus perpetuating the regular course of these fellings.

In the young woods of the first periodic blocks, the improvement fellings are at present cleanings (removal of soft woods and setting free valuable species) ; in the other periodic blocks they are ordinary thinnings, that is removal of suppressed, defective, or dying trees, setting free oaks, and sometimes in the 5th or 6th periodic blocks, felling certain old trees which cannot be expected to live until the 5th or 6th periods, and so well surrounded by the younger growth that there is no danger of the crop being over thinned.

YIELD ; NATURE OF FOREST PRODUCE AND MARKET FOR IT.

Yield.—The annual yield of the forest of Lyons is more than 988,837 c. feet of principal produce (from regeneration fellings calculated by volume), and of nearly 1,977 acres of improvement fellings, yielding more than 30,000 stères and 200,000 faggots, representing *847,575 c. feet or a total annual yield for the forest of* 1,836,412 c. feet, about 71 c. feet per acre.

This figure does not exceed the annual increment, and may be increased when a regular gradation of ages has been everywhere established throughout the forest.

The figure of 5,716 c. feet per acre, representing the actual mean volume of the mature standing crop now being regenerated, and of which the average age hardly exceeds 100 years, and which has already furnished a nearly equal volume under the head of thinnings, proves the correctness of this estimate.

Marketable produce.—The oak (sessile and pedunculate), the beech, hornbeam, wild cherry, birch, ash, and maple, are the chief marketable species of the forest of Lyons. We merely mention the aspen, sallow, and scotch pine, which up to the present time have only yielded produce in the cleanings, all faggots, except a few pine poles.

Oak.—Oak of good quality is exported from the forest in logs, or planks. Second-class trees are sawn up into railway sleepers, beams, or split into staves, park palings, wheel spokes, &c. The crowns of large trees and all small oak wood are sold for fuel.

Oak trees of moderate size are not much in demand. The price of oak railway sleepers has gone down almost to the same figure as for beech. Beams for use in construction, find few purchasers. This is due to the competition of iron girders, and of imported wood. Hardly any oak bark is sold in the forest of Lyons.

Beech.—The demands for beech have varied considerably during the last few years.

After having experienced a depression of nearly 6 per cent. from 1880 to 1886, owing to the cessation of the trade in railway sleepers, and to the diminution of that of sabots, beech has recently somewhat recovered in price ; railway sleepers are regularly sold from the fellings, certainly at rather a low price, but still this assures a sale for beechwood of large dimensions, and secures a better price for firewood.

The sabot industry also absorbs a number of middling-sized beech trees ; the finest wood is, however, exported in logs for the Parisian sawmills, or those of the neighbourhood, where they are converted into planks for furniture, or into coopers' wood.

A large proportion of the beech wood is used for fuel in the neighbourhood of the forest, or at Rouen and Elbeuf, some firewood from the centre parts of the forest going to Paris.

Hornbeam.—The finest pieces of hornbeam are used for the sabot and other industries ; most of this wood, however, is used for fuel in the same localities as beech wood.

Wild Cherry.—The wild cherry is greatly in demand for the saw-mills for chair making. Some fine trees of this species are found in the forest.

Ash.—Ash is only found of a limited size and is therefore only used for certain homely purposes, poles, &c. Very little wood of this species is large enough for wheelwrights' work, but there will be a fair supply when certain woods come under the axe.

Birch.—The same remarks apply here as for the ash. A few trees become large enough for sabot making, but the wood is generally used for fuel. This is also the case as regards the field maple, its dimensions being inadequate for other employment.

The sycamore and the elm are only found in plantations and have not yet come into use.

The other inferior species are only made into faggots coming from the cleanings, or in charcoal wood.

Scotch pine.—The Scotch pine is restricted to 148 acres in the forest of Lyons, and has hitherto only been felled in cleanings or thinnings, and furnishes posts for fences, and firewood.

Trade in firewood.—Firewood in the forest of Lyons is sold as split wood of different lengths, and as round wood 2ft. 2in. long, and as wood for charcoal. This last product is only of limited importance and its preparation only increases when the price of firewood is particularly low. Charcoal is then made, in order to reduce the transport and secure a rapid clearance of the fellings. Not more than one-tenth of the firewood is so employed.

Carbonisation is effected at Lyons, and in the forest in very small kilns of from 283 to 706 stacked c. feet.

The demand for faggots varies considerably, but on account of their relatively small number and the minute subdivision of the forest, a number of ready purchasers are secured.

Price of material.—The price of wood in the forest of Lyons has not only followed the general fall in prices which has prevailed during the last few years, on account of the competition of iron and imported timber, but this has been aggravated locally by the difficulty and the high price of labour.

The fact that firewood at Lyons is only worth three-fiths of its price at Rouen 24 miles distant, shows how important it is to improve the means of transport.

The average price of the cubic metre of standing timber, inclusive of stem, top, and branches, has been, during the last ten years $2\frac{1}{2}d.$ a cubic foot for the principal fellings, and $1\frac{2}{3}d.$ a cubic foot for the thinnings. This gives a mean annual revenue of 15,840*l.* or 12*s.* 6*d.* an acre, for the whole forest; or of 13*s.* 4*d.* per acre if we include the value of the minor produce.

This figure is very inferior to the normal revenue; it exceeded 1*l.* 3*s.* 4*d.* per acre in 1830, and it is to be hoped that it will soon go up at least to 16*s.* 8*d.* per acre, when the present commercial crisis has terminated.

Minor produce.—Independently of the saleable wood, and of the dead wood given away to the neighbouring poor people, the forest of Lyons yields certain accessory produce, the value of which *is realised either in cash or in daily la*bour.

First of all in the former category comes the game, which produces 880*l.* a year.

The total yield in money of the other minor produce, quarries, removal of clay, sand, ferns, plants, &c, is not of much importance, about 160*l.* The numerous quarries opened out in the forest cause a much greater loss than their receipts but their concession is necessary in the public interest.

Concessions of standing dead wood, of ferns, or heather, are repaid by daily labour at the rate of 70·6 stacked c. feet or 50 bundles for each day. The same may be said of pannage, one day for each pig during a season of six months. These days form a precious resource for the maintenance of roads, and the execution of urgent and unforeseen works.

Detailed Account of the Method of selecting Trees to be felled.

Seeding fellings.—In a normal wood of the dense growth found at Lyons, the trees reserved at a seeding felling are in number about one third of the standing crop, but only one half in volume,

as the finest middle-aged trees are selected as seed-bearers. The oldest beech are generally felled, as middle-aged trees are more fertile, and yield seed of a better quality.

Preference is always given to oak, already so scarce in the forest, and care is taken to concentrate the seed-bearers of this species, as its light shade requires concentration to protect the seedlings from frost and drought. The extraction of the stumps of most of the felled trees is a good preparation for natural regeneration, which is also facilitated wherever necessary by the use of the Bienvenu forest plough.

This plough, idvented by M. Bienvenu, at present Honorary Sub-Inspector of Forests, is constructed like a cultivator with three teeth, each placed on a spring strong enough not to yield in ordinary work, but only when it meets with an obstacle such as a root or large stone. A double lever also affords means of regulating at will the depth of the work, and of raising the whole apparatus so as to avoid obstacles, or portions of ground already stocked, which are not to be ploughed up.

The instrument is worked by one man and two horses, but on ground very weedy, or covered with brambles, two men are required, one to drive the plough, and the other to free the instrument from weeds from time to time. The best and most economical results have been obtained by the use of this instrument, which works fast and well. Hoeing is only employed in places where the soil is too stony or too steep, or in out-of-the-way places too small to repay the cost of transport of the plough. Owing to the necessity for working a great number of places in the forest, the operation is carried on both before and after the fall of the mast. The work done is useful in both cases; if before the fall of the mast, the latter gets on to loose soil and is covered by the dead leaves; if after it, a large quantity of mast is buried in the ground. The latter method is preferable in woods most frequented by red deer, especially by hinds. The plough costs 16*l.*

Secondary and final fellings.—The location of the fellings depends on the condition of the young crops and the limit fixed for the annual yield. In every working section, therefore, fellings considered necessary on account of the state of the young growth are always made before commencing to regenerate a new area by a seeding felling.

In the forest of Lyons, where the beech predominates, the work is facilitated by the faculty which this species possesses for supporting prolonged shade. As the oak differs in this respect, great care is taken to set free its seedlings as soon as this becomes necessary.

The course of regeneration being naturally irregular, the secondary and final fellings are frequently amalgamated into one, which is called a secondary felling in some cases and a final felling in others.

The secondary fellings generally follow six to eight years after the seeding fellings, and are themselves pretty quickly followed by the final fellings. The regeneration is therefore completed in from ten to fifteen years at the outside.

Compartments where the oak predominates form exceptions to this rule, and if the seeding may have to be awaited as long as for the beech, it is completed more rapidly, but unfortunately is more difficult to secure.

Thinnings.—Most of the thinnings are sold standing by *unit of produce* which method is profitable financially and sylviculturally. The trees to be felled are marked either with the forest guard's hammer or with the marker; the merchant then fells and converts them, the produce being afterwards measured and its price regulated at the rate agreed upon at the auction.

By this method, the forest officials can, at any time, during the felling, increase or correct the markings. The necessity for carefully preserving the oak in the Lyons forest renders this method peculiarly valuable.

As thinnings are made by area, marking for them merely follows sylvicultural rules. Generally they are limited to the removal of dying and suppressed trees; under the light cover of the oaks, even hornbeam of little promise is left, being useful in keeping up the density of the leaf cannopy. The operation follows nature, rarely forestalls it. The forester is guided also by the state of the crop and quality of the soil, marking lightly on poor soil and warm aspects, but more boldly wherever a vigorous growth allows him to reduce the number of stems without endangering the density of the woods.

While strictly respecting these rules, the compact condition of the woods renders the produce of the thinnings very large: the last thinnings executed produced more than 714 c. feet and 120 faggots per acre. Some woods actually yield 1,143 stacked cubic feet per acre.

Cleanings.—The cleanings are made at the expense of the State, and for them a special credit is afforded, whilst the produce is sold and the price credited to the State. These operations have for their object not only to thin out the over-dense thickets of young wood, but also and chiefly to protect valuable species, and especially oaks. With this object in view, one need have no hesitation in removing or pruning a beech, hornbeam, or other species which is threatening young oak saplings.

The sale of the produce of a cleaning frequently scarcely covers its cost, but their future usefulness gives them great importance. No markings can be made in these fellings on account of the great number and small size of the stems, and the work can only be entrusted to skilled workmen constantly supervised and directed by the guards and forest officers.

APPENDIX.

Note on Compartment E^2, Canton du Castelier, in the 12th working section. (Area 67·88 acres.)

This compartment contains 4,660 trees (173 oaks, 4,244 beech, 243 hornbeam), or 69 trees per acre. The trees have an average age of 160 years, with some old standards 180—240 years old. The average volume is 14,291 c. feet per acre.

Some sample areas chosen in the best part of the wood, show :—

1. *For the area containing* the trees largest in diameter, 48 trees per acre cubing 15,578 c. feet per acre, an average of 345 c. feet per tree.
2. For the part of the area where the trees are tallest, 81 trees, and 15,006 c. feet per acre, 185 c. feet for the average tree.

Taking the wood as a whole, the mean height of all the trees is nearly 184 feet, some trees even attaining 164 feet. The diameters at 3·3 feet from the ground vary from 14 in. to 43 in. and the law of diminution of these diameters (the rate at which the trees taper with elevation above the ground) varies *between 1 per cent. for* trees below 4·9 feet 3·3 feet from the ground, and at the most 2 per cent. for the tallest trees. The total surface of the horizontal sections of the stems measured at 3·3 feet from the ground is $\frac{1}{217}$ ths of the total area of the compartment.

COOPERS HILL,
6th July 1892.

Insects injurious to Coniferæ.

The following extracts from a valuable paper by Mr. W. F. H. Blandford, M. A., F. Z. S., &c.. published in the Journal of the Royal Horticultural Society, will be of interest to our readers.

"Of all families of trees, the Coniferæ suffer most severely 'from the attacks of insects, owing to the large number of species 'which they support, and to the difficulty which, on account of their 'physiological characteristics, they have in withstanding injury.

'The wide area over which forests of these trees extend 'increases the danger of insect-attacks, in accordance with a well-'known law which holds with injurious insects ; and it is among 'Coniferæ alone among trees, and among the forest-species of 'Pine, Fir, and Larch—for the Yews, Cypresses, Thuyas, &c, do

'not now concern us—that have happened those repeated instances 'of widespread destruction over large forest areas which, occurring 'even before economic forestry began to change the character of 'the primitive mixed woods, probably increased in number and 'severity at that epoch, and have continued at intervals to the pre-'sent day.

'A striking example of this destruction is that which happened 'in the period 1853-68, in East Prussia, Poland, and Russia, 'when the Spruce was killed over an area of 7,000 square 'German miles. A similar instance is that afforded last year in 'the Bavarian forests by the plague of the same destructive in-'sect (*Liparis monacha*); the loss caused by this to the revenue 'was estimated at £40,000.

'The immense importance of these attacks has given an im-'petus to the study of forest-insects on the Continent, and a not 'inconsiderable mass of literature has sprung up. In this the 'foremost place must be given to the works of Ratzeburg, who 'was the first to place this branch of entomology on a truly scien-'tific basis.

'In the large number of insects feeding on these trees, only a 'few are of habitual importance, but exceptional abundance of a 'normally unimportant species, will bring about unexpected damage. 'This sometimes occurs in Great Britain, and I have heard com-'plaints of damage which was not assignable to any of the regular 'destroyers, but which could not be identified in the absence of 'specimens.

'Now the standpoint of the systematic entomologist or of the 'collector, is not the same as that of the economist, and papers 'written by the one will not always serve for the enlightenment of 'the other. The former is apt to neglect certain small points bear-'ing on the habits of the insect which do not immediately concern 'him, and especially those connected with the appearance, vitality, 'and aftergrowth of the plant on which his prey lives; while the 'economist, more particularly the practical forester, who thinks 'more of the injured plants than of the destroyer, has occasionally 'a royal disregard of the sordid details of specific characters, which 'brings him into trouble when he discovers that closely allied 'species often have remarkably different life-histories. In writing 'the account of any new injurious insect, it is essential that an '*exact* determination of the species shall be made, and the life-'history constructed as completely as possible from personal ob-'servation, especially with regard to times of appearance, or if 'already recorded, it should be verified by observed facts.

'The special liability of some Coniferæ (*Pinus*, *Picea*, *Abies*, '*Larix*) to injury by insects, and the important character of such 'injury, are due to the following facts.

'1. There is a very large number of insects which attack 'them. Kaltenbach enumerates 299 on the forest conifers in 'Europe. This number falls, indeed, far short of the 537 assigned to

'the Oak, but neither list can be taken as strictly accurate. Many 'species are omitted, especially from the former list, while in the 'case of the Oak the number appears to be swelled by the dragging 'in of species having little real connection with that tree.

'In Ratzeburg's "*Forest-Insekten*" 95 species are tabulated 'as injuring Coniferæ, while only 36 are referred to the Oak; but 'subsequent researches would increase both these figures.

'2. Every part of the tree is liable to energetic attacks from 'one insect or another—the roots, the bark of the trunk and bran-'ches, the wood, needles, shoots, and lastly the cones, the seed-'production of which may be greatly lessened by insects feeding 'in their interior.

'3. A common form of injury, especially on the Continent, 'is defoliation. Now complete defoliation of a Conifer, other than 'the Larch, usually means the death of the tree, because of the 'slowness with which the injury is repaired.

'If an Oak is stripped by *Tortrix viridana*—an annual occur-'rence in many English woods—or a Hawthorn by *Hyponomeuta* '*padella*, as in our London parks and gardens, the tree generally 'grows a new crop of leaves late in the year, provided that the 'defoliation is sufficiently complete and sufficiently early; but if a 'Spruce or Pine be stripped and survive, not only are no further 'needles produced the same year, but next year's growth may be 'delayed a month, and the new needles are stunted and form the 'curious bristle-needles figured by Ratzeburg. The tree will take 'four or five years to recover its normal covering of needles, and 'with them its normal process of growth; so that during that period 'the total increment will only equal, or may even be less than, that 'of a single ordinary season.

'4. Defoliation renders a tree liable to the attacks of other 'insects, especially of the much-dreaded bark-beetles, which have 'so often completed the havoc begun in European forests by hordes 'of caterpillars. I do not intend to discuss here all the various 'aspects of the perennial and much-vexed question as to the econo-'mic importance of these and other wood-feeding insects and the 'susceptibility of perfectly healthy trees to their attacks, but refer-'ence to it cannot be entirely omitted.

'It may be true that bark-beetles and longicorns never 'attack a tree in perfect health; that is the opinion of many ento-'mologists, whose number by no means includes all those whose 'familiarity with forestry compels them to keep sight of the prac-'tical side of the question—men like Eichhoff, the leading author-'ity on these beetles and the head of a large forest-district, Judeich 'and Nitsche, &c. Yet a disease would not be considered unim-'portant by the physician because it rarely or never attacked the 'robust; if it occurred as the sequela of other complaints, killing 'patients whose recovery would have been certain, it would de-'mand serious attention. So these beetles, as the health of every

'tree in a forest cannot be assured, still possess importance even if 'their attacks are limited to the sickly plant.

'But though no one doubts that they, in common with all 'insects, prefer an unhealthy plant to a healthy one, they may not 'always reject the latter. Here in Great Britain there is great 'difficulty in arriving at a just conclusion, for many injurious 'species are unknown or are exceedingly rare, and it is dangerous 'to argue about the habits of any one kind from analogy with those 'of another. Though a species breeding in small numbers in a 'wood with plenty of brood-material may let alone timber which it 'would attack if it were present from any cause in immense 'swarms impelled by the necessity of egg-laying and with lack of 'suitable breeding-places, there is yet evidence that these insects, 'if dying or injured wood is not at hand, attack sound trees for 'egg-laying, and if the assault does not succeed, the large number 'of attempted burrows serve to weaken the tree, which may 'succumb after several repetitions. When it is recollected that a 'square mètre of bark has been known to contain nearly five 'thousand larvæ of *Tomicus typographus*, it will be seem that a 'large quantity of suitable breeding-material may cause an increase 'in the numbers of these insects that will jeopardise the healthy 'trees. A particular form of injury inflicted by some of these 'beetles is that of attacking and breeding in the crown and upper 'branches of old trees whose vitality is not great. This attack, 'which spreads down the branches till the main trunk is involved, 'has been described on certain deciduous trees, and is of importance 'as likely to be overlooked.

'Damage by storm, snowfall, frost, or by forest fires, or cater- 'pillar-defoliation, together with careless forestry and the slovenly 'accumulation of loppings, felled timber, and unbarked logs, serve 'to foster the development of such insects, till serious injury is 'risked. The thin-barked Spruce suffers more than the Pine, and 'it was the forests of this tree that were so terribly ravaged by 'bark-beetles in the Harz Mountains during the last century.

'That bark-beetles have been associated with destruction of 'trees over immense areas is undoubted ; and it lies with the advo- 'cates of the theory that their presence is immaterial to show what 'those forests would have died from in the absence of bark-beetles, 'instead of invoking mysterious and unnamed "diseases." The most 'serious attempt to prove another cause for the destruction of the 'trees is that of Lindeman, who associated the beetles with the 'presence of *Agaricus melleus*. This, however, appears to be un- 'proved.

'5. *Not a few insects feed during some part of their lives* 'on or in the young shoots of Conifers, in the leader or the extrem- 'ities of the lateral branches. When the leader perishes, the 'upward growth is checked until one or more branches of the top 'whorl twist round to supply its place. So lateral branches are 'destroyed or have their growth stopped, and the tree becomes

'altered in shape and appearance. Such mutilated Pines abound 'in almost all woods in the South of England.

'6. The practice of growing large pure woods of Conifers of 'uniform age tends especially to widespread ravages. Most Conifer-'feeding insects will not touch deciduous trees, and many are con-'fined to a single species of Conifer. Others, again, limit their 'attacks almost completely to a single period in the life of a tree. '*Curculio abietis* is very destructive to trees under seven years old, 'comparatively harmless to those of ten or more years. In a pure 'wood, the conditions favourable to increase of an insect pest exist 'over the whole area at once, and there is no limit to the supply of 'food, the facilities for egg-laying or for migration to fresh districts 'from the part infected.

'Under these circumstances, a bad insect attack localised in 'one spot of an extensive forest, is an exceedingly dangerous thing, 'and it has been necessary on several occasions to isolate such an 'area in a European forest and destroy it with fire to prevent the 'hatching of myriads of winged moths which would spread over 'the neighbourhood. The danger and expense of so drastic a 'measure are obvious. It is a universal rule that the larger the 'district cultivated with any particular plant, the greater is the risk 'of insect-attack, while small isolated plantations become infested 'with difficulty............"

In the body of his paper, Mr. Blandford describes what can be done to minimize the damage done by the particular insects he deals with and in conclusion he observes:—" No Conifer-wood can 'be kept free from the risk of insect-injury, unless it is freed from 'newly dead and dying wood, cut branches, and fresh stumps. There 'is no need for the systematic removal of the covering of needles, 'the natural protection to the ground, nor, as a rule, of small twigs 'and branches much under an inch in diameter.

'It is not rarely objected by those anxious to free a wood 'from insects, that this thorough cleaning is too costly to be put 'into practice. Without it the insects cannot be kept down, and 'it is for them to look at the cost of labour and the opportunity for 'disposal of such timber, and decide whether it is cheaper to let 'the insects flourish or not.

'The first cleaning-up of a neglected forest is no doubt costly, 'but after that has taken place, there is plenty of evidence to show 'that systematic and orderly removal of dead wood is profitable in 'the long run, unless exceptional destruction of timber over scat-'tered areas by storms or snowfall should unduly strain the 'forest resources.

'No one who is familiar with the pitiable appearance of a 'Pine-wood thinned out badly by *Myelophilus piniperda* can doubt 'that in this matter penny-wisdom sometimes leads to pound-'foolishness, and that in the end the practice of keeping the forest 'thoroughly clean—a practice advocated for many generations by 'scientific foresters—is the best and safest."

EXPERIMENTS REGARDING THE

Cover of trees reserved in Coppice with Standards.

An extract from a *Bulletin du Ministère de l'Agriculture* recently received, contains the results of numerous experiments made by M. Bartet, *Inspecteur Adjoint des Forêts* at Nancy regarding the Cover of Coppice Standards, by *cover* being meant the surface formed by the projection of the crown of a tree on the ground. The object of the experiments is to assist in deciding questions which the choice and application of different systems of reserving standards may give rise to. To avoid difficulties, the age of the trees has been completely ignored and in all cases the cover is compared to the diameter of the trunk taken at 1m. 30 above the surface of the ground and the cover is taken as being equal to a circle constructed with the average diameter of the horizontal projection of the crown. This surface has not been actually calculated, the calculations being restricted to determining simply the average diameter of the crown corresponding to each category of trunk diameter.

The method of measurement and the nature and situation of the trees experimented on, comprising some 616 Oak, 169 Beech, and 50 Hornbeam, are explained, and the results obtained tabulated.

The conclusions drawn from figures given in the table for the Oak are *first*, that whatever may be the nature of the soil and the age at which the coppice is exploited, the relation between the diameter of the crown and the diameter of the stem diminishes constantly as the standards increase in girth. *Secondly*, that the lateral development of the crown becomes slower and slower as the trees become old. *Third*, that for trees of a given size the diameter of the crown varies but little with changes in the rotation of the coppice or in the quality of the soil. The figures also show that so far as regards the relative development of the crown and the stem, the Beech and the Hornbeam are regulated by the same laws as the Oak.

The results obtained differ entirely from the theory hitherto adopted in the *Cours de Culture*, a difference arising entirely from the amount of cover allowed by the authors (Lorentz et Parade) for the average tree of each age class. In an example taken for a hectare, the cover obtained according to the *Cours de Culture* is not one half that obtained if the calculations be made according to the table above referred to, a result which will doubtless tend to modify the hitherto accepted principle that the standards in a coppice should not cover more than one-third of the ground immediately before the exploitation.

A. F. G.

Influence of aititude on the growth of Forests and Trees.

A most interesting paper is published in the *Allgemeine Forst und Jagd Zeitung* of November, 1892, by Dr. Seiroko Honda of Tokio on his enquiries regarding the influence of the height above the sea level on the growth of forest trees, and their reducing factor.

The enquiries and valuation surveys have been very searching and extended over areas of elevation ranging from 900 to 1050 metres, from 1050 to 1200 metres, from 1200 to 1350, and from 1350 to 1500 metres.

The results of the experiments are shortly summarized showing that with increase of absolute elevation of the locality, the following changes take place in the growth.

A.—The individual tree.

1. The increase in height lessens regularly and distinctly.
2. The basal increase also decreases, but less so than the growth-height.
3. Increase in volume lessens gradually.
4. The stage of immaturity in all these directions is prolonged.
5. The form of the bole becomes less and less cylindrical and approaches more and more the neiloid.
6. The proportion of the increase of the several parts of the tree decreases from the bottom towards the top of the stem.
7. The reducing factor becomes smaller.
8. The crown formation gets lower in proportion to the bole.
9. The proportion of small branch wood increases.

B.—Of the Forest.

10. The actual number of stems per area increases, whilst, however—
11. The number of stouter and dominant trees decreases.
12 The mean height of the forest decreases.
13. The total basal area decreases, not very apparently, but belongs to a great extent to trees of inferior growth.
14. The outturn in timber, scantling and first class wood decreases distinctly.
15. The outturn in small branch wood increases to some extent.
16. Trees of the same age are more inclined to form groups

The article is worthy of perusal and study.

Timber Physics.

We have received a printed copy of the first of a series of bulletins on Timber Physics compiled by Mr. B. E. Fernow, Chief of the Forestry Division, U. S. Department of Agriculture, which has been published by the authority of the Secretary of Agriculture. The object of the bulletins is to record the results of an extensive investigation into the nature of the important woods of the United States, especially their mechanical and technical properties and the dependence of these upon structure and physical condition and upon the conditions under which the wood was grown. The bulletin now under reference is preliminary in its nature, being intended to serve as a basis for the work which is to follow and is partly begun.

The first part of the memorandum is devoted to the " Need of the investigation." Mr. Fernow points out that the properties of the various timbers are not well-known and that while attempts more or less systematic have been made to determine these properties there does not exist much reliable published information for general use. Several instances are given of the waste of valuable material which has resulted from this ignorance ; for instance, the employment of fine black walnut timber for fence rails, posts and firewood ; again until twelve or fifteen years ago many million feet of hemlock (*Abies canadensis*) were left to rot in the woods after the bark had been taken for tanning purposes, or this timber was not cut at all, because its value for building purposes was not understood or was underrated. Another instance is given of how, in Alabama alone, an annual saving of $40,000 to $50,000 has been effected by utilizing the wood of the chestnut oak for sleepers on the Louisville and Nashville Railroad, a large amount of which wood was a few years ago allowed to rot, the tree being felled for the tan bark alone.

Mr. Fernow states that it would be impossible to estimate the direct and indirect losses which the country suffers from ignorance as to the true values and strength of its building timbers. A *résumé* of some hundred letters received from leading engineers, scientific societies and others, is appended to his report, which, while strongly favouring the thorough investigation of the U. S. timbers, are of interest also as showing the multiplicity of directions in which the work would be of benefit.

The investigation known under the name of " Government Timber Tests," which is to be the most comprehensive of the kind ever undertaken anywhere in the U. S. or in Europe, is stated to

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" Timber Physics, Part I, compiled by B. E. Fernow, Chief of Forestry Division, Washington, 1892

differ from all former attempts in that direction, in that it starts out with the fullest recognition of three facts.

"(1). *That in order to establish reliable data as to mechanical* 'properties of our timbers, it is necessary to make a very large 'number of tests by which the range as well as average capabilities 'of the species is determined.

'(2). That in order to enable us to make the most efficient 'practical application of the data thus obtained, it is necessary to 'know the physical and structural conditions of the test material 'and bring these into relation with the best results.

'(3). That in order further to deduce laws of relation 'between mechanical properties and the physical and structural 'condition as well as the conditions under which the material was 'produced, it is necessary to work on material the history of which 'is thoroughly known."

After certain remarks on the necessity of making the tests on a large number of specimens of known origin and known physical condition, Mr. Fernow adds "While some experiments would lead 'us to believe that specific weight is a fair expression of the strength 'of timber of the same species, yet it would be hazardous to rely 'upon this factor without regard to other physical conditions and 'structural features of the timber."

Such ring-porous woods as the oaks and ash show the greatest strength and elasticity when their annual rings are wide, while the slow-grown mountain oak seems to excel in stiffness. From conifers, on the other hand, according to Hartig, the slow-grown timbers seem to exhibit superior quality; hence those from rich soils are not desirable. This again has appeared doubtful or, at least, true only within unknown limits from Bauschinger's experiments which showed that tensile strength in pines was independent of the total width of the annual ring but dependent on the ratio between the spring wood and summer wood. That wet soil produces brittle, dry or fresh soil tough, timber, is believed, but needs proof. Contrary to general opinion, the time of felling seems to be without influence on the strength of pines. The degree of seasoning on the other hand seems to increase the strength, although it would still have to be found out whether the manner and rapidity of seasoning may not change this result. Toughness or capacity for bending without rupture on the contrary, is claimed to be inversely proportionate to seasoning.

The second part of the memorandum treats of the scope and historical development of the science of "Timber Physics," the subject matter comprised in this branch of applied natural science being arranged as follows :—

I. Wood structure or Xylotomy.

(*a*). Exterior form (*b*) Interior structural appearance (*c*) Minute anatomy or histology, (*d*) Classification of woods according to structural features.

(*e*) Laws of wood growth (*f*) Abnormal formations.

II. Physical properties.

(*a*). Exterior appearance, (*b*) Material condition (*c*) Classification of woods according to such physical properties as determine their application in the arts.

III. Chemical properties.

(*a*). General chemical analysis of wood (*b*) Carbohydrates of the wood (*c*) Extractive materials (*d*) Antiseptic materials (*e*) Mineral constituents.

IV. Mechanical properties.

(*a*). Form changes without destruction of cohesion.

(*b*). Form changes with destruction of cohesion.

V. Technical properties.

VI. Diseases and faults.

VII. Relation of properties to each other.

The history of previous works carried out in this connection is then given and the third part of the memorandum devoted to the "Organization and methods of the Timber Examinations in the Division of Forestry."

The work, as at present organized, is carried out by four departments *viz* :—

1. The collecting department.
2. The department of mechanical tests.
3. The department of physical and microscopic examination of the test material.
4. The department of compilation and final discussion of results.

The bulletin concludes with a description of the different methods employed in carrying out the various experiments ; instructions for the collection, &c., of test pieces, blank forms and illustrative records and finally drawings of the machinery, &c. required for carrying out the experiments.

The Nepal Khedda on the Ganges.

With the permission of Government, the elephants of the Nepal Khedda, under the orders of the Superintendent, Major Jeet Singh Bahadur, have been permitted to march from the Nepal territory along the foot of the Himalaya in order to try and capture some of the wild elephants which are to be found in the forests of the Dún and in those on the left bank of the Ganges opposite. Accordingly, for the past two or three weeks, the whole party with no less than 275 elephants of all sizes have been camped at Chila close to Hurdwar and engaged in the endeavour to catch such herds and single elephants as were heard of in the neighbourhood. The camp was an enormous one, and a very strange sight, some of the elephants being splendid animals. Two, notably, were of enormous size and very powerful brutes, the biggest of all being a huge tusker named 'Narain Gaj.' In order to assist the Superintendant in his work, Mr. F. A. Leete, Assistant Conservator of Forests, was placed on special duty, and he has been good enough to inform us of the results to date. They have not been very successful, only ten elephants in all having been caught so far. Of these, one small calf was allowed to go and also one very old and quite useless animal; while one other has died since capture. This reduces the spoil to ten. No captures were made in the Dún, though there was a curious incident which we describe in Mr. Leete's own words. "On the 31st, the Khedda 'crossed into the Motichur after the Bagh Rau rogue, found him, 'chased him and surrounded him; but he showed fight and so 'Narain Gaj was brought up against him. Narain Gaj, however, 'did not stop soon enough, for he knocked the life, as well as the 'spirit, out of the tusker. The latter was knocked over and died 'on the spot and he is there now (all but his single tusk) if jackals, '&c., have not found him." This will be a disappointment to the Ex-Amir of Cabul, for the rogue had been proclaimed and Yakub Khan had obtained permission to shoot him.

Another single tusk rogue had previously been captured with some trouble near Chila. The Khedda camp will not now come west of the Ganges, but they still expect to get some good sport towards Haldukhata.

The best Engine for a Saw-Mill.

M. POWIS BALE, M. INST. M. E.

Almost every type of engine is made to do duty in a saw-mill, and as many of them are utterly unsuited to the work, the result is often anything but satisfactory both on the score of economy and effective working.

Owing to the severe and variable duty required of a saw-mill engine, it should be of especially strong and substantial construction, and able to command a uniform speed under suddenly applied loads.

After a lengthened experience, the author is of opinion that the best form of engine for driving wood-working machinery—except under special circumstances—is a long stroke horizontal high pressure, either compounded or with a condenser, or both. Some years ago, the author, in writing on some points to be desired in a saw-mill engine, mentioned the following, and as his views in this respect have not altered, it may not be out of place to repeat them.

(1) A stroke of twice the diameter of the cylinder ; (2) either compounded or with a condenser, or both ; (3) or an automatic expansion slide, controlled by powerful and sensitive governor gear ; (4) a steam-jacketted and lagged cylinder ; (5) short steam ways ; (6) ample bearing surfaces, well fitted and lubricated, and an efficient method of packing ; (7) large cylinder area per h. p. ; (8) a fly-wheel of large diameter and extra heavy section ; (9) a moderate piston speed.

Speaking generally, in selecting an engine, the chief points to be borne in mind are:—(1) The nature of the work it has to do ; (2) the speed and power required ; (3) the cost of fuel ; and (4) if under skilled management. In a saw-mill, if the fuel be plentiful, and the management unskilled, as is often the case in isolated countries, a plain slide-valve engine would possibly suit better than a first-class one with expansion gear, condenser, &c., the loss of fuel being partly compensated for by the greater freedom from breakdowns. In this case, the engine should be arranged to cut off steam tolerably early and expand it for the rest of the stroke, and powerful governor gear should be employed. On the other hand, in establishments where large power is required and skilled management is attainable, the most advanced form of engine is in the end by far the cheapest. In cases where fuel is dear, a good

compound condensing engine can be used with advantage ; but it cannot be too often repeated that, where extreme economy is required, a skilled engine driver is an absolute necessity. If the steam pressure by which an engine is worked would be likely to vary considerably, and the load likewise vary; to secure steady and even running, the engine should be fitted with valve gear having a considerable range of cut-off, combined with a powerful and sensitive governor.

In selecting an engine, a full detailed specification, giving sizes and materials, should be obtained from the maker, with his guarantee as to horse-power—brake horse-power, if possible—the engine will give out at a certain steam pressure, and that it will work at its full speed and power without excessive vibration.

See that the bed-plate and frame and working details of the engine are of ample strength, also that the cylinder has sufficient metal to allow of its being rebored several times, that the steam passages are short, that the sliding and bearing surfaces are ample, and that they are adjustable for wear. The author prefers a medium piston speed—say 500 ft. per minute, to higher speeds, as he has found the cylinders of large horizontal engines run at high speeds rapidly wear hollow.

An engine of ample, but not excessive, power, for the work to be done, should be selected, as too large an engine is as wasteful of steam as too small a one.

For saw-mill work, the author prefers the bed-plate of the engine to be on the double girder box plan, and to extend beyond the cylinder, which should be mounted on it, as this is undoubtedly the best form to resist heavy working strains. If a pair of engines are used, it will be found well to have one large fly wheel for the two engines, placing it between them, with an extra pulley for driving the main shafting. Crankshaft to be fitted with an outside bearing. Connecting rod ends to be made adjustable for wear, and fitted with straps and keys. Engine to be fitted with wide double motion bars and blocks, and made adjustable for wear. The bars should have oil recesses and grit cavities. Stop and starting valve to be provided and so arranged that access can be had to the throttle valve without disturbing the steam pipe. The steam passages should be large, short, and direct, and the clearance in cylinder as small as possible.

For driving woodworking machinery, after repeated trials, I am distinctly in favour of an engine with a long stroke, as it permits a higher piston speed without excessive vibration and wear and tear, and the steam can be expanded with greater facility. The steam ports should be as short as possible. This can be secured by dividing the slide valves, placing them at each end of the steam chest ; and a high-speed sensitive governor should be arranged to act on an equilibrium double-beat thottle valve, or on expansion gear. The exhaust should be of ample size, to admit of the instant

escape of the steam and avoid back pressure. In crowded spaces it is sometimes necessary to use a vertical engine ; these can be compounded with advantage, and although necessarily of shorter stroke, they can be worked with less wear to the piston, cylinder, glands, &c., than a horizontal engine, the wear being distributed, whilst in a horizontal engine the cylinder wears oval.

Arrangements should be made for the continuous drainage of the cylinder, and it should be fitted with a good sight feed lubricator, which is a distinct improvement over ordinary grease cups, as with these latter the piston may be running perfectly dry, and the cylinder may be scored and the rings cut out before the attendant is aware of it. A very considerable economy in oil is also effected by the use of a sight-feed lubricator as it can be adjusted to supply the minimum amount of oil to keep the cylinder properly lubricated. On the other hand, the old-fashioned grease cup floods the cylinder with oil for a short time, and, this being rapidly cleared away by the strokes of the piston, the cylinder is left comparatively dry in a little time.

Compound engines have of late years come considerably into use, and are more economical than single cylinder engines. This arises chiefly from the fact that much higher pressures of steam can be expanded with greater advantage in two cylinders than in one, and without the considerable loss from condensation which arises in a single cylinder when the steam is cut off very early in the stroke. Again, if a considerable range of expansion be attempted in a single cylinder, and the cut-off is very early, the strain on the working parts is great, necessitating excessive weight and strength in the engine. In the case of compound cylinders, however, this strain is distributed.

In single cylinders, if large expansion be attempted, the steam condensation is excessive and becomes a serious matter. Compound engines will work more steadily and with less friction and vibration, consequently the general details of the engines may be made lighter. Where a sufficiency of water is obtainable, a condenser can be fitted to an engine with considerable advantge, as in this case, instead of being exhausted into the open air or water tank after each stroke of the piston, the steam passes through the exhaust part into the condenser, and, coming in contact with the water, which is in constant circulation therein, is itself immediately condensed or reduced to water. In working the condenser, an air pump is employed, which keeps up a vacuum and relieves the piston from back pressure, thus increasing the effective power of the engine. The water made hot by the condensation of the steam is again used to feed the boiler, hence a second saving arises.

A simple aud convenient arrangement for working the air-pump for a condenser is to prolong the engine piston-rod through the back cylinder cover. The air-pump should be double acting, and the valves arranged so as to give ready access for adjustment and repairs. The engine-bed should be prolonged and

the condenser mounted on it, so as to secure perfect alignment. The author has found pump valves of indiarubber, with gun metal seats, guards, and bolts, work very well. If there is no overhead tank for the injection water, sluice valves will be found most useful for starting the engine.

Automatic expansion gear is especially useful in a saw-mill, and with varying loads effects a considerable saving, as the admission of the steam is regulated according to the speed or load on the engine. The gears of Corlis & Proel have proved themselves very effective.

Another advantage arising from the use of automatic expansion gear is that the steam is always delivered to the cylinder at the highest available pressure, whilst in the case of an ordinary slide valve engine where the cut-off of the valve is always positive, the admission of the steam is governed by means of a throttle valve the action of which "wire draws," and reduces the pressure of the steam. With efficient expansion gear the amount of steam required to do the work on hand at the moment is practically measured at every stoke of the engine, and no more is used than is required, and this in turn is fully exhausted of its energy by expansion.

Owing to the constant and great variation of the load in a saw-mill, it is important that a governor be fitted sufficiently powerful to keep the engine perfectly under control, and the speed uniform. Various forms of high speed governor have come into use, and several of these have proved themselves both sensitive and quiet in action, and are to be preferred to the older-fashioned type.

Another very satisfactory arrangement of automatic expansion gear is the Ruston. In this the cut-off valve is made multiple ported to give free admission of the steam, and is driven by a radius rod, the free end of which is moved up or down in an oscillating slot-link, which is driven by a separate eccentric, the precise position of the rod being determined by the governor. As the speed of the engine increases and the governor balls rise, the travel of the expansion valve is reduced, and the steam is cut off earlier; should the engine run more slowly, the contrary occurs. The range of cut-off is from a fraction up to half a stroke.

For the guidance of readers, I append a specification of a high-class engine, well adapted for saw-mill work :—One improved horizontal compound tandem condensing engine to indicate 340 horse-power mounted on double girder box plate, planed on face; high pressure cylinder, 18 in. diameter; low pressure cylinder, 34 in. diameter; stroke of pistons, 36 in.; number of revolutions per minute, 90; d iameter of vertical air pump, 20 in.; stroke of vertical air pump, 18 in.; diameter of horizontal air pump, 14 in.; diameter of crank shaft, 10 in.; made of best fagotted scrap iron; diameter of fly-wheel, 18 ft.; width of face of fly-wheel, 28 in; diameter of stop valve on high pressure cylinder, 5 in.

To be fitted with Corliss' Variable Expansion Gear, on high-pressure cylinder, and ordinary slide valve on low-pressure cylinder. *The cylinder to be made of best hard cold blast iron, to be* steam jacketted, and with steam chest to be fitted and lagged. Connecting rod, slide and pump rods, to be of best faggotted scrap iron, and the piston rod, pins, keys, &c., of steel. All pins, joints, &c., subject to special wear, to be case hardened. Valves and plunger of pump to be of gun metal. All journal bearings to be of best gun metal or phosphor bronze, to be made adjustable for wear and efficient means of lubrication to be secured. An efficient sight feed lubricator to be fitted to steam cylinder, eccentric straps to be of gun metal, and made adjustable for wear. The whole to *be finished to the satisfaction of Mr.*———,

In conclusion, I may add :—Do not be persuaded into purchasing a low priced engine or boiler under any circumstances, as you may rest assured that it is impossible to purchase a first-class equipment at the price of a common one. The loss sustained in a day by using a poor engine and boiler may not be great, but this, multiplied by a series of years, may amount to an enormous sum ; in fact, in some cases, enough to buy a first-class plant several times over.—(*Timber Trades Journal.*)

Edinburgh University Forestry Lectures.

The introductory lecture to the Course on Forestry in the Edinburgh University was delivered recently by Colonel Bailey in the Agricultural Classroom. Among those present were Professor Bayley-Balfour, Professor Wallace, Dr. Cleghorn, of Stravithie, Colonel Dodds, &c.

Colonel Bailey said that originally it was intended to complete the entire series of about one hundred lectures before the close of the winter season; but, after consulting several gentlemen well qualified to offer an opinion on the question, he had decided to ask the permission of the University Court to divide his course into two parts. The first part would deal with forest botany, or the structure and growth of trees; and the second part with sylviculture, comprised under which would be the habits of trees and their behaviour under the influence of heat, light, moisture, climate, various classes of soil, &c., the more important sylviculture systems under which trees were grown in masses, and the creation and treatment of woods under these systems. These two subjects would occupy the winter season, and the other subjects—such as mensuration and valuation; working plans, or the organisation of woods in such a manner that they might best fulfil the objects for which they were maintained; forest pathology, or the diseases of trees and their treatment; and the utilisation of forest produce—would be taken up during the summer, when opportunities for making excursion

were greater than during the winter season. The new arrangement would have this advantage also, that if he could alternate the first and second parts in such a way that the second part might be taken first next year, and the first part second the year after, and so on, a student would be able to follow the whole course, either in a single year or in two consecutive winters or two consecutive summers. Colonel Bailey then explained further the nature of the course—mentioning that he meant to use Dr. Schlich's "Manual of Forestry" in dealing with the general part of sylviculture. He had been told, regarding books originating elsewhere than in the United Kingdom, that it was sometimes objected that they taught "Continental forestry," which did not apply to this country. But he did not recognise Continental, Scottish, or any other special kind of forestry. The principles which should guide the forester were the same all over the world, and these were what he proposed to set forth in that part of the course. He was aware that there were some excellent books on the subject by Scottish authors, but these would have greater value in the special part of the course rather than in the general part of which he was now speaking. The more their eyes were opened by a study of the general principles on which the science of forestry was based, the better they would be able to appreciate the special conditions with which they had to deal and the sooner they would be able to assist in building up, for the treatment of each species of tree flourishing in this country, a complete system which could be unhesitatingly accepted by their successors as one which rested on a solid foundation of recorded facts to the observation of which they would be guided by the researches conducted by the most eminent foresters the world had produced. In concluding, Colonel Bailey said he might mention a document that recently came into his hands, viz., the Board of Agriculture's building specification, which did not permit the use of Scottish timber in agricultural buildings without special permission. It permitted the use of Canadian, Norwegian, and American timber, but not Scottish timber, without special permission. That seemed to him to be a slur on the proprietors and forests of this country. He was in correspondence a short time ago with a proprietor in the North, who said to him, "What is the use of our learning forestry in this country? Here we are prohibited by the Board of Agriculture from using Scottish timber for building purposes." He (Colonel Bailey) wrote back to him and said that "if there is any 'such provision it must be because you grow bad timber. I do not 'believe the Board of Agriculture desires to prevent the use of good 'timber." He (Colonel Bailey) got the specification, and there he found it stated that Scottish timber could not be used without special permission, and that that should only be accorded by the inspectors when it was sound and seasoned, showing that the experience of the Board of Agriculture had been that proprietors were in the habit of using timber of a bad sort. What he (Colonel Bailey) would like to see established would be such a mode of wood

management in this country that the Board of Agriculture should revise that specification and should strike out this evil and, he would venture to say, insulting clause. (Applause). He perhaps would not give offence if he added a few remarks on the extraordinary ignorance which seemed to prevail regarding this matter of forestry. It was his belief that very few people outside of what he might call the "magic ring" realised that there was anything in it. A man who lived in the country and had seen trees as he walked, perhaps, to and from church, fancied he knew all about them. He fancied that Professor Bayley-Balfour, and Professor Wallace, and some others in the room could tell them a different story. He ventured to think it was a very wide and a very abstract science, that required deep study and that involved a knowledge of several cognate sciences. He hoped the time was not far distant when they would find that the people of this country were as thoroughly acquainted with the general facts of the question as he knew they were in France and Germany.—(*Timber Trades Journal.*)

Burmese Amber.

Dr. Otto Helm, of Danzig, has submitted the following report on a piece of Burmese amber. He writes ;—Dr. Fritz Noetling, under orders of the Director of the Geological Survey of India, has sent me a piece of amber-like resin from Upper Burmah. *I have, as far as the small quantity of material would permit,* made a chemical and physical examination of the specimen, and I hope to follow the publication of this preliminary investigation with a further contribution.

The fragment under examination is covered with a thin weathered crust of a brown colour. When broken it exhibits a shining, conchoidal fracture, with a greasy touch. The internal colour is dark yellow, some parts being transparent, and others sub-transparent, the latter being beclouded with organic matter, finely disseminated through the substance of the resin. The specimen exhibits a fine blue fluorescence. If light be sent into the interior with a convex glass lens, the cone of light appears of a golden yellow colour. In polarised light, the same colour is exhibited, changing, however, by revolution of the Nicols through 90° to blue and orange.

The resin is as easy to cut, saw and polish as the Baltic amber (Succinite); it is a little harder, however, than the latter, its *hardness varying between 1·5 and 3.*

Its specific gravity is 1·034.

As to the chemical constituents of this fossil resin, I am not yet able to give an ultimate analysis, as the piece in my possession

exhibits no portion of perfectly clear colour, but is clouded throughout by finely disseminated particles. I have, nevertheless, made a dry distillation of the resin, and the results are extraordinarily interesting and different from those which other fossil resins give under like conditions. During the distillation, for which I used a glass retort, there first appeared a white vapour cloud, which, on cooling, condensed to water-white drops ; subsequently the vapour became tinged with yellow and condensed in thin oily streaks ; ultimately, the cloud was dissipated and thick oily drops flowed into the receiver. The distillate is a brownish yellow oil, with tarry consistency, of a peculiar burnt smell and an extremely small quantity of a watery liquid. I treated this liquid with hot water and filtered : it was water-white, and gave an acid reaction with litmus paper. On repeated distillation over a steam bath, a liquid distilled over and a yellowish residue remained behind which I cleaned by solution in water with subsequent filtration and evaporation. The small quantity of crystals thus obtained I recognised, by well-known reactions, to be pyrogallic acid, whilst the aqueous distillate contained formic acid. Succinic acid was not found in the products of distillation.

The resin contained 0·6 per cent of ash which was composed of iron-oxide, sulphuric acid, carbonic acid, and lime. I found a very small quantity (0·013 per cent.) of sulphur in combination with organic substances.

The fusion point of the resin cannot be determined, as before that point is reached it decomposes with evolution of a white aromatic vapour.

The resin proved to be very resistent against solvents :—Chloroform dissolves only 2·2 per cent of it. Alcohol dissolves 0·8 per cent, the solution leaving behind, on drying, a black-brown resin. Ether dissolves 2·4 per cent, the solution leaving, on evaporation, a clear yellow resin. By oil of turpentine 18·5 per cent was dissolved, whilst carbon bisulphide dissolved 4·6 per cent.

If the pulverised material is treated with concentrated sulphuric acid, the resin gradually dissolves, forming a solution of a red-brown colour, which blackens on heating. When the red brown solution is treated with water, a dirty white deposit separates out. Concentrated nitric acid at the ordinary temperature has little effect on the resin, but on heating, the latter is changed into a yellow friable substance.

By friction, the resin becomes electric, and retains its electricity for some time.

From the foregoing investigation, it seems that the Burmese resin differs from all the fossil resins with which I am, up to the present, acquainted ; and I shall continue this research as soon as further specimens of clear colour are available. *(Memoirs of the Geological Survey.)*

The Timber trade on the Yangtse.

The British Consul at Hankow noticing a great growth in the timber trade in the great river owing to the decrease in the inland transit dues, says that for many years the high transit duties imposed, amounting often to over 100 per cent., *ad valorem*, checked the trade, which the natural features of the country—steep declines easily formed into timber-shoots and swift torrents capable of floating the timber to navigable streams—should have facilitated, and which the very low charge for labour in the forest regions should have made profitable. Lately, however, these dues have been lightened, and the consequence has been an enormous extension of the timber trade at Hankow. Most of the timber goes down the river in the form of huge rafts. These, with the huts erected on them for the raftsmen, looking like floating islands, are a remarkable feature of the river landscape of the Yangtse; and the floating timber yards where these rafts are lashed together reach for some six miles along the north bank of the Yangtse at Hankow. The value of these rafts must be enormous, but they do not appear in the trade returns for the port. Owing to the increase of both rafts and foreign shipping, collisions were at one time frequent, giving rise to acrimonious and troublesome disputes, which, however, the Consul has now succeeded in obviating by inducing the Chinese to accept certain simple regulations.—(*Weekly Times*).

THE

INDIAN FORESTER.

Vol. XIX.] March, 1893. [No 3.

On Forest Settlement and Administration.

It appears from an article in the April 1892 number of the *Indian Forester*, by Mr. Baden-Powell, who has had good opportunities for forming a correct opinion, that the way in which the forests have been settled is, generally speaking, not entirely satisfactory. The same conclusion has, I dare say, been arrived at by others who have had much to do with settlement work. In the earlier days of the Forest Act, the chief object of the settlement officer was, so far as my experience goes,* to "reserve" as much as possible of what he considered really valuable† forest; to "protect" the whole of the remaining waste-lands after leaving a margin for the extension of cultivation; to declare the whole area free of rights; to grant concessions freely all over the protected area; and to keep the reserved area free of all concessions. This mode of procedure enabled the 'settlement' to progress rapidly, as, although some care was deemed necessary in the selection of reserved areas, but little trouble was taken in the selection of the protected areas which was often done in a very summary, hap-hazard fashion. It also fell in entirely with the view generally held that this was the only mode of selection which would enable villagers to have ample areas of the permanent forest lands from which to help themselves to produce and in which to graze their animals at will. The one advantage of the system, from the forester's point of view, was that it gave to the Forest Department certain areas over which it was intended that the latter should have full control, and over which, as a matter of fact, it was given full control. A disadvantage was that these areas of protected forest, often largely exceeding the reserved areas, were invariably situated in the most frequented and populous parts of the country, in the vicinity of towns, villages and cultivation, and were really far more in need of settlement (in the interests of the surrounding population) than the reserved areas.

*It is scarcely necessary to say that these remarks, as well as those which follow, have reference only to the somewhat limited sphere which has come under my own observation.

† *i.e.* These areas which were stocked with the biggest and most marketable trees. Other economical matters were not thought of.

At that time, however, the general feeling in the Revenue Department, and to a certain exent also, the feeling in the Forest Department, was against reserving any area which could not be declared free of rights and concessions, and it would have been quite impossible to reserve more than a fraction of the permanent forest area. It was thought that reservation under Chapter II of the Act would give unlimited powers for evil to the Forest Department; and that Reserved Forest should, if only for this reason, be confined as much as possible, if not entirely, to areas that could be reserved free of all rights and concessions. In a great measure owing to these mistaken notions of the object and effect of reserving forests, Revenue Officers were generally at bottom dead against Reserved Forest at all and the oddest thing was that no amount of explanation regarding the aims and consequences of reservation under Chapter II served to disabuse their minds of the conviction that that Chapter had been introduced into the Act, by the Forest Department, with a view to defrauding villagers of their rights, or to convince them that it was in the least degree applicable to forests in the immediate vicinity of inhabited tracts. Even now, many seem to hold mistaken views on the subject: otherwise, it would be impossible to explain the antipathy to reserved forests often manifested in recommendations regarding quite recent settlements.

Of late years there has been a tendency to reserve a proportionately far larger area, and even to convert some of the originally protected areas into reserved, but the control of the reserved, as well as of the protected, is rapidly slipping, or has already slipped, away from the Forest to the Revenue Department. This transfer of authority over areas which it is desired to maintain *permanently* as forest is, I consider, to be regretted. How is it possible to have confidence in the management of a department which has so persistently and so blindly opposed sound settlement and management? In a leading article in the October number of the *Indian Forester*, it is asserted that the constitution of reserved forests in many parts of Madras is ascribable to the co-operation of Revenue Officers consequent on their being given a larger share in the management of forests. But could they help themselves? Had not the *fiat* gone forth that areas intended to be kept permanently under forest should be *settled*? Is not the fact now more generally recognized that reservation and the exercise of rights and concessions are compatible? And has not the Revenue Department been fully compensated by getting complete control—if not nominally, at all events practically—of the forests, into its own hands? But if these reasons are not sufficiently convincing, and it be still maintained, by the writer of that article and his followers, that the reservation of certain areas in Madras is to be ascribed to the cause alleged in the article, that fact would also prove the unfitness of Revenue Officers to deal fairly with forest affairs, since they have, according to the writer of the article, to be bribed to take right action by the concession of a larger share in the management of the forests. I do

not see how men who have neither the requisite training, nor the practical acquaintance with forest affairs necessary for a thorough understanding of forest questions or of agricultural matters connected with forest management, can be expected to deal satisfactorily with forest affairs except by pure chance ; but apart from this consideration, their training and surroundings constitute a powerful incentive to act in a way unreasonably harmful to the forests. A special function of Revenue Officers is to look after agricultural interests ; and, in all questions in which the farmer is directly or indirectly concerned, he is admittedly represented by the Revenue Officer, who cannot fail to approach these questions with a biassed mind : the two offices of Advocate and Judge cannot be combined. I do not blame him, all I say is that no person so situated is fit to decide between the claims of agriculture, on the one hand, and of forest conservancy and administration on the other. I think it was Sir Richard Temple, who used to talk of "physically educating" Revenue Officers up to a rational and impartial treatment of forest affairs. It would be as reasonable to hope to educate a pack of wolves into guarding a flock of lambs;* education will do much, no doubt, and if the subjects of examination taken up by candidates for the Civil Service of India were such as to develop the faculties and a knowledge of the subjects most necessary for a member of that service, our forests would assuredly receive more rational treatment ; and their position in the national economy, as well as their right management, would be more easily appreciated by men whose influence for good or evil is out of all proportion to their knowledge of things and consequently, to their power of drawing correct inferences from what they see.† If some attention were paid to forest and cognate subjects, fewer inter-departmental disagreements would arise on pure matter of fact. Such a

*Not that I would liken Revenue Officers to wolves, but the metaphor expresses the idea intended—you cannot deprive an individual of his natural instincts unless you remove the cause which, in the present case, is, *inter alia*, the championing of the so-called (not always real) interests of agriculture.

†This may appear, at first sight, to be too strong a statement. I have no wish to exaggerate, and I do not think I can be accused of over stating the case. What is the business of a Revenue Officer ? Certainly not the study of classic mathematics, or modern languages, and yet these are the subjects which alon enable the majority of candidates to get into the Civil Service of India. Subject calculated to develop the best work by a Revenue Officer, to enable him understand the nature and bearing of many questions with which he comes in daily official contact, and to cultivate the faculties of observation and scienti method, are comparatively neglected ; while the sciences of agriculture, engine ing, forestry, sanitation, and possibly other matters of the greatest practi value to him, are entirely neglected. No sensible person would ever drean educating, *à la* Macaulay (I believe he was the man who introduced the pr system) a youth intended for the naval profession, or more correctly spe of educating him on the lines which Macaulay's system has led to ; and ye lines are quite as well suited to the navigator as to the Civil Servant. Thin changed a good deal since the earlier days of the competition-wala ; he was a less ambitious man in those days ; at any rate in our day, literary or mathematical education will not suffice for men who aspi a leading part in the decision of all the technical questions of the d

misapprehension of the facts as is involved in the statement, for example, that kumri-cultivation on the precipitous mountain slopes of Southern India is eminently conducive to tree growth, and that therefore, it should be encouraged, would at all events, be impossible, as well as many equally ill-founded statements of a different nature advanced by Revenue Officers in all good faith, in their eagerness to make out a case for what they consider to be the interests of agriculture.

My contention is, then, briefly this, that Revenue Officers as a class, are unfitted by education and by the force of circumstances that surround them, to deal fairly with forest affairs, and that the history of forest administration shows that, as a class, they have steadily opposed the rational treatment of forests. Some of them, at least, virtually admit this. Sir Richard Temple did, and so does Mr. Baden-Powell. The opinion of the latter is the more valuable in that he has had more varied practical experience of forest matters, and has devoted more time to their study, than any other member of his service, past or present. It is worth while, therefore, to give a few extracts from his paper, already referred to, in which he repeatedly accuses Revenue Officers, as a class, of incapacity to regard forest affairs seriously or in their true light. He accuses them of holding the view "that ordinary forest offences do no harm," that "careful forest preservation, 'implying protection against trees, is only needed for a very 'special and limited class of plantation and for valuable teak and other 'first class woods. And it is held that for the great bulk of forests, no 'particular care is needed ; and that (of course excepting gross acts 'of destruction) everybody may be left to take wood, grass and 'bark, and to graze cattle freely at all times, and in all places, as he 'pleases ; and that, though the forest may not, under such free and 'easy treatment, produce 'gigantic teak trees,' still it will yield, and 'go on yielding, all that is practically necessary." Again, "the 'majority of officers cannot get rid of the idea that no matter how 'numerous or extensive the demands on a forest are, no care is 'needed in periodically closing any part; no unpalatable restrictions 'need be placed on the quantity, or mode of acquiring it, the yield '*will go on for ever*, as long as produce is only fairly taken and acts of mischief, as distinguished from acts of mere appropriation, are repressed. The absolute fallacy of this idea, it is to be feared, will ıot be established, till our forests are experimentally ruined before ›ur eyes, if indeed (and here is the misfortune) the ruin, which is ·ot less sure because slow, is not delayed beyond the ordinary ficial lifetime of any one officer. To this inveterate belief is, fortunately, to be added, the intense fear of unpopularity and distent." These, then, are, according to Mr. Baden-Powell, some of ·stacles to rational management under existing circumstances, ·y are pretty stiff ones, too. Nobody wishes to deny that now ı we come across Revenue Officers who rise superior to their ·ent and admit the necessity of establishing rational

management in all forests which are considered to be necessary for the welfare of the country, who recognize the facts that must be faced to attain this object, and are prepared to face them. But it is quite natural that a far greater number should, in spite of the facts, take a very different view of the necessities of forest management, and this course is all the easier to the many, who, as pointed out by Mr. Baden-Powell, are incapable of perceiving the disastrous effects that the adoption of views similar to theirs has brought about in the past, nor the evils that the adoption of their policy is destined to bring about in the future. It is, therefore, a misleading and empty phrase to talk of enlisting the sympathies of Revenue Officers. That object could only be attained by smothering their much stronger feelings in the direction of *laisser aller*. Still less is it possible to " enlist the sympathies of the villagers," a much abused phrase of which we hear so much whenever it is desired to abandon scientific management or to grant them unnecessary concessions. Theirs is, even more than that of the Revenue Department, a hand-to-mouth policy, and they naturally treat as an excellent joke, any suggestion that they should exercise the slightest self denial or even care in order to preserve some of the forest for the use of those who are to come after them, although they may, and often do, recognize well enough the destruction that is going on, and the consequent evils in store for their descendants.

We often hear it said that the Forest Department should have full control of technical matters while the Revenue Department controlled the non-technical. Theoretically, this may appear to be an excellent arrangement, but those who think so, should tell us how it is to be put into practice. Theorists omit this important part of the programme. A few years ago, not *quite* recently—he has scouted many of his professions since then—Mr. Gladstone said, with reference to Home Rule, that to separate Imperial from Local business 'passed the wit of man.' We may borrow the phrase in the present case, and say that to separate the technical from the non-technical passes the wit of man. Surely this must be obvious in a thousand ways to everybody. Take, for instance, the familiar case of a closure against grazing. The actual prohibition certainly cannot be called a technical affair, but it may be the first and only step in the preparation of the soil for the reception of the seed and *the only practicable means to that end* and as such would be a technical operation (although the Revenue Officer might not see it) on which the very existence of the forest would depend. Who then is to say what is technical and what is not technical ? And yet in all questions regarding the apportionment of control between the two departments, how much stress is apt to be laid on this point, and what tremendous castles in the air are erected on the assumption that the two functions can be sharply defined ?

This fact—the impossibility of separating professional from non-professional functions—should therefore, be recognized. Until this is done, and until the principle is generally admitted that

Revenue Officers, as a class, are incapable of holding sound views regarding the management of forests, there can be little hope of lasting progress or of continuity in forest administration as a whole. When these facts are generally admitted, it may be possible to affect a compromise by means of which the Forest Department shall be enabled to fulfil the function for which it was presumably created and to manage its own affairs, or at least to have a predominant voice in the matter. It would be preferable to have a much smaller area well managed than to have the whole of the present area worked in a half-hearted manner which ensures the maintenance of no portion. A further measure which will be found to be necessary will be the appointment of a Forest Officer to each province as Secretary or Joint Secretary to Government in the Forest Department, as suggested (I think) in an article in the *Indian Forester* for October. Excepting the Burmese, no Local Government has a professional adviser attached to the Secretariat, bnt there can be little doubt that, if continuity in regard to forest affairs is to be ensured, and misunderstandings are to be avoided, a measure of this kind will be found to be necessary.

One word more before concluding. This paper may possilby be read by a member of the Revenue Department. In that case, I would express the hope that he will not take offence at a bit of straightforward criticism and plain speaking, without which it would be impossible for me to make out my case in favour of fuller control by the Forest Department of the forest estates, which it is considered necessary to permanently maintain for the welfare of the country.

FUTAIE.

Injury by Insects and the value to Forests of the Enemies of these Insects.

TRANSLATION BY S. E.-W.

Under the above title there is an interesting Article in the *Forst und Jagd Zeitung* for October, 1892, by Dr. Adalbert Seitz. The author commences by remarking that in spite of the voluminous literature on this subject, there is still a want of uniformity in opinion in questions of forest zoology, which is sometimes painfully evident, as for instance in the discussion of laws prohibiting the destruction of birds, etc. He proposes to lay before the reader a *resumé* of the observations made during a five year's tour through natural and artificial forests in all parts of the world, not in the hope of settling for ever disputed questions, but rather with the thought of bringing them again under final discussion. Before entering on the subject of the enemies to insect life, it will be well to say a few words on the influence of insects, an influence which can only affect forest or agricultural interests when insects appear in abnormal

number. The reasons for such appearance must therefore first be discussed, happily it is only under abnormally favorable conditions that an abnormal swarm of any insect can occur in nature. Calamities caused by excessive production of insect life have been attributed to a disturbance of the natural equilibrium existing in the animal and vegetable Kingdoms, and man has been held responsible for such disturbance, but the author places no faith in such an equilibrium, for personal observations made in all parts of the world have revealed to him a constant fight for existence resulting frequently in the disappearance of some species. Further, if such an equilibrium existed in nature, there could be no questions of natural development and improvement in organic life: it would require the interference of man to cause the disappearance of one species and the appearance of another. Even if this much talked of equilibrium existed in nature, how would it be possible in cultivated areas where we have instead of moorland, wheat fields, and instead of virgin forests, plantations? That such changes must influence insect life is incontestable, but a few of the conditions which regulate the increase or decrease of that life must first be considered. The most potent factor with regard to this is Climate, and moths (which are the most important forest insect because they not only strip the foliage but by weakening the tree expose it to the future ravages of beetles) are, of all insects, most influenced thereby and although these climatic influences are most complicated in their action, yet careful observations lead to certain valuable conclusions. That the average annual temperature influences insect life may be gathered from the fact that the appearance of various insects shows a periodicity agreeing with the eleven year weather cycle. The years 1797, 1808, 1819, 1840 were remarkable for the damage done to forest growth by insects. No information is, unfortunately, forthcoming regarding 1830. The periodicity thus noticed is not a peculiarity in Europe, it has been long ago remarked in America. *Swinton* found that a few species which were under special observation for 44 years, swarmed plentifully in the years 1835, 1846, 1857 and 1868 and were scarcest in 1840-41, 1851-51, 1862-63 and 1873-74. The increase was always in the year of minimum area of sunspots, the decrease in the years of maximum area of the same. It cannot be considered extraordinary that the dates first quoted above do not agree with those entered below, for it must be remembered that the observations were made only in reference to a species, and the appearance of insects in abnormal numbers is influenced by other conditions than climate. In point of fact, in the years when one species is specially strongly represented, other species seem to disappear entirely; but when we consider climatic influences in detail, we arrive at results which are not forthcoming when we, as we have hitherto done, treat of climate generally. For instance, a mild winter is antagonistic to the increase of insects with a generation period of one year and which pass the winter in the larva stage. The reason of this well-known

fact was said by *von Frohawk* to be that, in mild winters, fewer insect-eating birds are destroyed by the severity of the climate, and the greater frequency of these birds in the following spring accounts for the decrease in the number of insects. The influence of birds on insect life has, however, as compared with that of climate, been much over rated, and *Barrett's* explanation appears to be much more probable, namely, that the mild winter conduces to breaks in the period of hibernations with the resulting decrease in the number of larvæ. It has frequently been remarked that with abnormally warm weather in December and January the caterpillars of *Bombyx rubi*, *Gastropacha pini*, and other species leave their winter quarters prematurely, only to die in thousands when, to them, unexpected cold weather again sets in. Late winters have also a harmful effect in the increase of some species. For instance, *Orgyia antiqua*, in years when a long and fine autumn has occurred, produces at the end of October a third brood, consisting almost entirely of male insects, for this reason that the female caterpillars, which form their cocoons much later, have not had time to complete the metamorphosis ; it is of course a great disadvantage to the increase of the species that the majority of the males should appear in autumn, whilst the females do not appear till the following spring.

An unusual dryness and poverty of sap in the food-plants of insects, has an adverse influence on the development of the larva, so it is evident that hot and dry summers have also a pernicious effect on insect life, because slow development and late metamorphosis must increase the danger to the individual insect ; in point of fact, dry summers are marked by scarcity of perfect insects and the large number of cripples and abnormal types that are found.

The power of resistance to meteorological conditions varies much with the species ; for instance, the caterpillars of *Gastropacha pini* have been found in hollows which were during the winter full of rain water, and even frozen hard, so that it was possible to break the caterpillars in two or more pieces, yet when this frozen mass was thawed in a warmer atmosphere, the caterpillars at once revived. On the other hand, it may be remarked that, as the mean temperature of any locality falls, the northern limit of the species is proportionately restricted, and the reason of the disappearance of certain species from certain localities is frequently attributable to this cause. For instance, in the summer of 1880, in England, some butterflies disappeared altogether, whilst others became scarce and *Carrington* attributes this to the severe cold of the preceding winter ; *Melitaea aurini*, which was common in Sussex up to 1834, does not exist there; whilst *Bryophila muralis* completely disappeared from Wiesbaden since the occurrence there of a heavy frost in May 1876. Insects, moreover, do not only differ in the ability of withstanding extremes of heat and cold, but also in the manner they are affected by changes in the weather. As every species is not in the same stage of development at periodically recurring

changes in climate, such changes must necessarily react in various ways in various species. In this circumstance lies the explanation of the fact that similar weather may result in the annihilation of one species and the increase of another.

After favorable climatic conditions, the most important factor in the increase of insect life is that of favourable weather during the breeding time; if all the individuals of one species arrive at perfection together, the chances of fructification of the individual are much increased. *Orgyia pudibunda*, in ordinary years, exists as a perfect insect, from April to July ; in 1889, however, all the moths of this species appeared simultaneously and ten days after not a single specimen could be found. It can be imagined what an effect in the increase of a species such an occurrence would have when the sexes did not have to wait for days exposed to all adverse influences before procreation took place. For many species, indeed, the possibility of procreation within a very limited period is a *sine quâ non* of continuance of the species ; for instance, *Zenzera aesculi* swarms only for one night and thereafter disappears ; *Cosmia pyralina* is common in some localities, but is not frequently met with, because all the individuals of the species are developed within a period of three days. If, therefore, the weather during the short breeding time is unfavourable, the species may become for years almost extinct. Many species are, however, protected against such eventualities, as development is not completed save in favourable weather, provided always that unfavourable weather does not continue too long. In such cases, when, for instance, it rains during the whole of the breeding time, a hitherto common insect may be entirely rooted out ; as, in 1859, *Aglia tau* in Stuttgart. It is also the case that many insects, especially beetles, when hindered by unfavourable climatic influences, let a year pass by in waiting for the next season ; for instance, *Sphinx ligustri* appears in England in the middle of June, but if the metamorphosis is not completed by that date, the larva remains till the following year, when the perfect insect appears. The moths which swarm in winter must frequently be obliged to remain in the cocoon for long periods, awaiting favourable weather; thus, *Endromis versicolor* sometimes remains two to three years in the cocoon ; *Asteroscopus nuleculosus* three to four years and *Bombys lanestris* frequently five years. In spite of this, however, abnormal weather frequently causes irregularities in the numbers of insects; it is known that cockchafers frequently appear (when in the larva stage) above ground at all seasons of the year, a proceeding which generally leads to the death of the individual ; and butterflies frequently develop in winter and are found dead in the snow. Although the influence of the weather is most felt by butterflies or moths which live more or less in the open, yet these influences also affect the imperfect insect when in the larva stage ; during the casting of the skin, the caterpillar finds difficulty in moving and its grasp is feeble, so that the effect of a storm is often to cover the ground with dead and

dying insects. After a storm, over one thousand caterpillars of one species have been found under a single tree. The dangers of storms to insect life are increased by adverse combinations such as rain and wind, or rain and cold ; in such cases, insects may be beaten to the ground and lose their powers of flight, or killed outright by the force of the rain. Thus, a wet and cold summer in 1888 followed by autumn frosts completely prevented an expected calamitous swarming of *Orgyia pudibunda* ; grubs of insects do not generally perish on account of flooding of their resting places, but die in large numbers when frost follows on such flooding.

As a conjunction of unfavorable circumstances is necessary to the extinction or diminution of any species, so any marked increase is impossible without the presence of many favorable conditions; a single favourable season is, as a rule, not sufficient to ensure this result. *Kane* remarks that although a hot summer results in a scarcity of insects, yet in result the following year is favourable to an increase ; and it has been ascertained that *Leucania unipunctata*, which is so harmful in North America, requires two favourable years before the devastating army of caterpillars can be formed. The unusual warmth and dryness of the spring of 1889 permitted the injurious swarming of *Gastropacha pini* and prepared the way for the devastations of the "Nun" in the following year. This would not have occurred if the weather of 1890 had not also been favorable to insect life ; for instance, more moisture might have killed off the insects in large numbers. However favorable climatic circumstances may be, abnormal increase in any species cannot occur unless under certain conditions; and, as already pointed out, many of these conditions and the most important of them are due to the interference of man. As the author was roaming along the banks of the Silver River in 1889, the terrible devastation caused by the caterpillar of the *Oiketicus Kirbyi* was specially remarkable, but what was most astonishing was that the greatest harm was done in the cultivated strips of land, the uncultivated portions had been spared ; so that, though everywhere the foliage was swarming with caterpillars, it was only on cultivation that the bushes were bare of leaves. In the spring of 1890 the author observed damage by caterpillars in the South of China. Opposite Hongkong, is a peninsula where conifers had been planted to ameliorate the climate ; beyond this artificially raised forest, extended naturally grown conifers which, however, were sparse, and consisted only of young or old and injured stems. The area under artificial growth had been severely injured by an insect, whilst in the natural forest not a caterpillar or moth was visible. These experiences agree with those of other observers. Wandering foresters have noticed that in the immense forests of North America, which, sad to say, are ever decreasing, few or no forest insects were seen ; the forests of the wild west do not suffer from insect pects, whilst in those of the Eastern States, where cultivation is extensive and extending, these have already appeared, but not yet

in overwhelming numbers. Thus, here also, the experience is arrived at, that, owing to improved sylviculture, insects that have before escaped the notice of the Forester, have now become an ever present evil; in fact, the extraordinary increase of the insect plague in the last sixty years appears to be favored by a rational system of agriculture and sylviculture. In spite of this knowledge, the reason for this remarkable fact is not yet evident, although some of the causes are not far to seek. The choice of species when creating a forest is of the first importance. It is known that certain trees are peculiarly sensitive to injury and afford nourishment to many species of insect; whilst others again only support one or a few species. As examples of this, the willow and the plane tree may be taken: the first is liable to injury by insects of many families, some of these are common on the trees, others confine their depredations entirely to the willow; there are, indeed, some forty species of insects which, more or less, affect this tree, of which about twenty are the larvæ of moths. On the other hand, the wood of the plane tree is very seldom injured, and there are only four species of insect which, occasionally, devour the foliage of this tree. Many other examples could be given in a similar manner; for instance, the aspen and the oak on the one hand, and the maple and horse chestnut on the other; it would indeed be possible to arrange a plantation which, beginning at one end with the lime tree and ending with the cypress, would show with great regularity the constantly decreasing predisposition of various trees to injury from insects. Further remarks on this subject would be here out of place; the conclusion, however, may be accepted that, as a rule, such plants should be cultivated that are in their original habitat, and that those exotics have the fewest enemies which are introduced into a country where similar species or those nearly related to them already exist. Of course, there are exceptions to this rule, as to every other; for example, the fuschia, which, on its introduction into California, was much ravaged by an insect which previously lived on an Epilobium; but a few exceptions cannot be held to upset any rule. An agricultural pest, *Mamestra oleracea*, makes itself at home on almost all exotic plants, on Begonias, Pelargoniums, etc., but, as a rule, it lives on cabbage and does no injury to other plants. Beyond the question of the suitable choice of species, the increase of certain insects is determined by the action of man in regard to the method of cultivation; for instance, the existence of close canopied pure forests permits of the passage of insects from tree to tree in search of new pasture; whilst, if the nature of the forest compels the insect to descend the tree in this search, the suppression of the undergrowth favours the larva in discovering new food supplies. Further, the removal of all undesirable tree growth tends to diminish the source of supply and thus many a hitherto harmless insect has been forced into becoming a danger to sylviculture. As an instance of this, take the case of the *Tortrix pilleriana* which lived in the immediate vicinity of the vineyards on various plants, but

when the Vineyards were cleared of weeds, caused great devastation amongst the vines. Another insect, *Plutella xylostella*, caused much damage in Mauritius amongst cabbages and turnips, simply because only useful plants were permitted in the fields ; in Europe the same insect does little harm because it is capable of finding, and allowed to find, a living on plants worthless to man. Considerations of this kind explain the great power of resistance to damage by insects, so long known to be a strong point in favor of mixed forests ; but under this term, the mixture of age classes as well as of species, should be understood. *Altum* has proved that in young pole forest, the enemies of the larvæ of certain forest insects are much fewer than in older forests ; and the question naturally follows whether the admixture of older stems in a pole forest would not naturally increase these welcome enemies of insect life. In another work it has been shown that certain insects whose food is in no way dependent on the growth of large trees, are yet, for reasons unknown to us, dependent for their existence on the presence of such trees, and disappear when these are removed. We must therefore consider it an unfavorable condition for sylviculture when our forests are so regulated that our natural allies in the war against insect life cannot or will not visit them. It may also be noticed that certain insect pests which are reared n arable lands enter and devastate the forests when their former home provides no further food supply, and, as an instance of this, may be mentioned the *Agrotis segetum* which has been known to destroy the foliage of the oak.

(*To be continued.*)

Beetles which girdle Rose-bushes.

We have received from the Director of the Forest School some correspondence on this subject. The beetles were found by Mr. Foster, Deputy Conservator of Forests in Coorg, who wrote :—"These beetles cut off the stems clean in one night and large rose trees are thus cut down and destroyed." The beetles attack the main stem and girdle it, cutting away till the bush falls. The specimens were sent to Mr. E. C. Cotes in Calcutta, who stated that they were insects of the *Cerambicidæ* Family, belonging to a species as yet unnamed. He considered them identical with insects noticed by the Collector of Kurnool as attacking the branches of a *Tabernæmontana*, a habit which they share in common with other kinds both in India and in America, and notably with a species *Cœlosterna scabrata*, Fabr. which was found by the Conservator of Forests in Oudh to damage sal saplings (See *Indian Forester*, Vol. XIV p. 503.) Some years ago we remember Mr. R. C. Wroughton sending some branch specimens from Bombay. Mr.

Cotes says that the objects of the beetle is to kill the branch with a view to laying its eggs afterwards in the dead wood above the ring. Mr. Foster says, however, that they cut the stem clean off and that after the severance is complete, the beetle remains at the top of the separated stem.

The Forests of the United States of North America.

Under the above title, Sir Dietrich Brandis has published a pamphlet of 44 pages which is reviewed shortly in the *Forst und Jagd Zeitung* for October 1892. The work is recommended to the notice of those who, interested in the growth of exotics, have already directed their attention to the peculiarities of forest growth in distant countries. Dr. Brandis, from his long experience in the East Indies, is especially in a position to draw instructive comparison between the vegetation of India and that of North America, and the opportunity for the issue of his pamphlet was given by the publication, during the last few years, of many works on the subject of the forests in America.

Amongst others may be cited ; Sargent's Report on the forests of North America in 1884 ; Semler's "Tropical and North American Forests" in 1888 ; Mayr's "Forests of North America" in 1890; Fernow's "Industrie Forestiére" in 1889 ; and Kessler's "Forest Notes from America" in 1890. Dr. Mayr's work has chiefly been taken advantage of by Dr. Brandis in order to compare his experiences with those of that author ; and although his observations in most instances tend to prove the same results, yet in some instances, he arrives at different conclusions. Dr. Mayr, for instance, holds that evergreen broad-leaved species require more warmth than broad-leaved deciduous species ; and that, in the tropics, as there is no alternation of seasons, there are also no species which for a period of the year remain leafless. Dr. Brandis naturally objects to these theories, so far as the forests of India are concerned. Some other conclusions arrived at by Dr. Mayr are also carefully investigated. For instance, that author states that the heaviest and most resinous pine wood grows in the south ; so far at least as weight is concerned, these good qualities diminish in more northern localities and the most northerly species of pine "*Pinus Strobus*" yeilds the lightest, if not the most resinous timber. Again the falling off in the length of the needles of the various species of pine, is more dependent on the habitat of the tree, than on warmth and moisture. The more northerly species have the shortest needles. Dr. Brandis, on the other hand, finds that there is no connection between the weight of the wood, length of needle and climatic conditions in the habitat of the various species of pine in India. Another point of difference in North American and Indian forests is pointed out by

Dr. Brandis. Dr. Mayr arrives at the conclusion that the absence of tree growth on the Prairie *Zone is due to insufficient rainfall* during the period of active growth, although the average atmospheric moisture is sufficient ; and although this may be the case in America, yet in certain localities in India, this conclusion will not be valid.

With the exception of certain differences, similar to those above stated, both Dr. Brandis and Dr. Mayr are in agreement in the conclusions drawn from their study of, and experiences in, the forests in India and North America.

O. C.

Right of Way.

Our attention has been drawn to a decision passed in 1886, by *the Forest Settlement Officer of Malabar,* in the case of a claim under the Madras Forest Act to right of way from a coffee estate through a Government Forest to a road. The following is the order of the Settlement Officer referred to. It shews very clearly the distinction between 'rights' and 'privileges,' or, as they are 'better called, 'concessions.'

"It is manifest that no legal right has been established, and 'also, having regard to the provisions of section 15 of Imperial Act 'V of 1882 (The Indian Easement Act, 1882) that no prescriptive '*easement operating as a right against the State* has been 'proved. The claim to enjoy the right of way as of right must, 'therefore, and is hereby, wholly rejected. This rejection does not 'interfere with the concession made by the District Forest Officer 'and referred to in column 6, it being distinctly understood that the 'concession does not operate as a legal right and is withdrawable 'at will."

"These privileges are not claimed as right, but merely asked 'for as a matter of favour. It is not within the province of this '*Court to deal with requests, but to determine claims. It will* there- 'fore suffice to record that no legal rights are granted over the 'several paths referred to in column 4, but the District Forest 'Officer expressed his willingness, as by favor, the concessions not 'operating as rights, and being withdrawable at will."

The Forage plants of Australia.

In a land like Australia where the breeding of stock is the chief agricultural industry of the country, the importance of an accurate knowledge of the different native fodder plants, cannot be underestimated, and the appearance of this publication of the Department of Agriculture of New South Wales, shows that the Government of the Colony is fully alive to its value. The book gives a series of pictures of 92 important fodder plants of various families, excluding the grasses; and each plate is accompanied by an appropriate description of the plant and of its qualities as a fodder. Twenty-five orders are represented, but by far the largest number of species figured belong to the family which gives the different kinds of ' Salt-bush' the *Chenopodiaceæ*, for no less than 37 of the plates refer to members of the family. The next largest order represented is *Leguminosæ* with 13 species. Then come *Cruciferæ* and *Myoporineæ* with 5 each, *Sapindaceæ* with 4, *Malvaceæ* and *Amarantaceæ* with 3. The last plate in the book gives the "Nardoo" *Marsilea Drummondii*, a cryptogamic plant allied to the Ferns, upon which the unfortunate explorers Burke and Wills were compelled to endeavour, for a while, to support existence. Stock of all descriptions, however, are said to be very fond of it and the Australian aborigines also use its spore cases for food.

It is interesting to find that the author was at one time disposed to think that a free introduction of exotics would be well in order to supplant the native herbage. Experience, however, has made him change his mind, and the stock animals themselves bear him out, as it seems that they prefer the indigenous to the introduced kinds of grass. Of interest to us in India, is Mr. Turner's opinion that tall growing grasses, even such kinds as *Reana*, *Sorghum*, maize and the big species of *Panicum*, are scarcely ever so nutritious as the more dwarf ones. Here in India, where the native cattle graziers think it so necessary to burn the grass in the forests for grazing purposes, they forget, as we have more than once pointed out, that thereby they destroy the smaller more nutritious kinds and foster only the growth of the tall species, which, except in the form of quite fresh shoots, are almost always hard and inedible. On the question of this annual burning, the following remarks of Mr. Turner fully deserve quotation.

"It has often been asked of me whether I favour the annual ' burning off of grasses. Except in three cases, I am decidedly ' against burning off, for the following reasons :—

1. "It destroys millions of grass seeds which an occasional 'good season may have brought to maturity, thereby destroying 'the only natural means for their reproduction. A fire also des-'troys many valuable Salsolaceous and other plants. 2. After 'burning off, if favourable weather ensues, new growth is made '*quickly, and sheep turned in on this eat greedily of it, which gives* 'them what is commonly termed the scours or diarrhœa, which often 'becomes chronic, and, of course, has such a weakening effect upon 'them that many die. Nor is this all, for in biting out the young 'growth from the heart of the plant, much of the latter is brought 'with it, which of course partially destroys it. If a fire 'should take place, sheep should never be turned into the pasture 'until it has made considerable growth, though cattle may be turn-'ed in without any serious damage being done, for they never eat 'grasses so low as do sheep. I may here mention the fact that '*sheep destroy the natural grasses and herbage in much less time* 'than horses, and they again much sooner than cattle.

"I am in favour of burning off annually under three such 'peculiar conditions as the following :—1, where grasses are much 'diseased with parasitic fungi ; 2, where there is a predominance 'of spear grasses ; and 3, where there are growing such rank 'grasses as those I describe as suitable for wet or undrained soils, 'for along with this coarse growth many noxious plants and fungoid 'pests are destroyed. (Very rarely good pasture plants other than 'grasses, will grow in such situations.) Pasture in these circum-stances becomes more *healthy, the fire acting as a disinfectant* 'and contagious diseases disappear. Grasses that will grow in low, 'damp situations, are a valuable standby for the pastoralist during 'protracted droughts."

These remarks are of the greatest importance, and although in the past 20 years a very great advance has been made in the teaching not only of the people of this country, but also of their rulers, that fire is not a necessary aid to the provision of good pasture, there are many people still who adhere to the old notions and think no good pasture is obtainable without fire. As an object lesson in the advantages of protection of grazing lands from fire, we know of none more valuable than what can be seen any day in the Nilgiri mountains of South India, by any one who examines the grass of the 'downs' where it is regularly burnt and consists chiefly of tussocks of coarse wiry kinds, with bare patches between, and that of the fire protected slopes of Dodabelta where even in dry seasons may be obtained good grazing on tender species of nutritious value.

The plates are rather roughly done, but to our mind bear the stamp of accuracy and seem faithfully to represent the common appearance of each plant. They seem to have been cheaply done by some process of nature-printing, aided afterwards by careful drawing. The preface contains an important acknowledgement by the

Minister for Agriculture of Mr. Turner's services in the cause of the grazing community by the publication of this useful little work. We wish there were a similar one for India, with the grasses given also in addition to other kinds of common fodder plants.

'The Forage Plants of Australia' by F. Turner, F.L.S., R.H.S., Published by the Department of Agriculture, N. S. Wales.

A Trip to Bara Bangahal.

1st June.—Up early and started immediately for Bhêtli Gote. The tramp through the fine old Pine Forests in the cool fresh morning was very enjoyable. The number of wind-fallen trees all along these forests, with a northern aspect, is enormous, the ridges in many places are denuded of trees. While all hands were engaged in pitching tents and getting the camp settled, the old Shikary and I strolled away over some very steep ground to prospect the country. Across the ravine opposite to us was spotted a brown bear, but he was on the move, and we soon lost sight of him; soon after we sighted another higher up, but he too was going as if the devil were after him, he was a fine specimen, and so we made a great effort to meet him near the snow line, but never saw him again. As it was getting dark we scrambled down the hill again, as fast we could, and on the opposite spur we caught sight of two more bears both of which were rushing about in a most curious way, which puzzled me very much, I asked the Shikary if this was the pairing season, and if these excited males were in search of females, of course he did not know, but if the "Sahib" thought so, it must be right. Not one of the four bears we had seen this evening halted for a single moment to feed.

2nd June.—Bhêtli Gote. Decided to halt a day here. While having "chota hazri" outside the tent, got "khabar" that two bears were feeding in a 'gote' on the opposite hill, the rifles being ready, we started immediately, and after crossing a deep ravine with a steep pull up on the opposite side, we came close up to the pair, they had evidently scented us, for they very uneasy, and kept looking down in our direction, so I took a hurried shot at the larger one of the two and rolled her over; reloading quickly, for I only had a single barrel rifle, I meant to take a shot at the other bear as he ran past us, but had suddenly to change my line of fire, the old she bear, who had recovered herself and come down towards us looking very angry and savage, the second shot finished her, but the cub made good his escape. This decided me to invest in a double barrelled rifle as soon as possible, for one is not only liable to

get chawed up before one has time to reload, but many a good chance is lost of bagging game from the want of a second barrel. Returned to breakfast and spent the rest of the day answering a post received during the night, and inspecting some patches of Blue Pine Forests.

The whole hill side here is covered with lilies of the valley and a variety of lovely wild flowers. In the afternoon, scrambled up to the snows to see the view from the higher peaks, saw another large bear in the same excited state. There is no mistaking the males, for they are larger, heavier built, and have a decided hump of thick hair over the shoulders. Killed an adder near the tent.

3rd June.—Awoke early, feeling very tired and seedy. Had breakfast early and started for the lower valley near the village of Bara Bangahal. Was much interested in watching a large flock of sheep crossing a very narrow and rickety bridge over the Ravi, which is a foaming torrent here, I fully expected one-half of them would have been hustled over the sides of the bridge by the others, but the old gaddi shepherd understood his business, and got them over wonderfully, he couldn't however prevent his flock getting hopelessly mixed up with two others on the opposite side, and I fully expected, there would have been no end of a quarrel on separating the flocks, for none of the sheep were marked in any way, and I was much astonished to see how each man knew his sheep and separated each his own without an angry word passing their lips.

4th June.—Up later than usual, feeling very unwell, and started for the Roygár valley about 7 o'clock. The Ravi, covered over with snow, in places 20 feet deep, forms the base of the valley, the slopes on either side are covered with Blue Pine, and occasionally deodar in the lower end of the long valley. The winter was an unusually severe one, and avalanches more numerous. For several miles the slopes were covered thickly with fallen trees heaped one on the top of the other, the result of avalanches, which had rushed down the slopes and covered the Ravi below. The road lay for some distance over the bed of snow which covered the Ravi, the foaming waters of which could be distinctly heard roaring below. The cold was intense and I felt unwell and had finally to give in; taking shelter under a large rock, I lay down to rest and sent my breakfast cooly to get some water, I had just dosed off to sleep when the cooly returned very excited and said he had seen a very large bear in the next clearing. I was not at all inclined to leave my sheltered resting place, but the man was so certain that the bear was really a fine specimen, that I determined to go and see. We soon reached the clearing at the end of which, there was certainly the finest old bear I had ever seen. The ground was covered with huge stones brought down by avalanches, and the stalking was therefore easy. I got at last an easy broadside shot at him at about 80 yards and was delighted to see him roll over into a snow

drift below. For a time we lost sight of him and I began to fear I had lost him, but hurrying up the ridge of snow, we came right on to him, and what a monster he looked as he raised his enormous head, and glared at us. Fearing to lose him, I gave him a second shot through the head, and finished him. His skin and stuffed head now hang on the walls of my hall, rare trophies of a very pleasant trip in the snowy wilds. As soon as the excitement was over, the bilious attack returned with greater force, and I had at last to double up under a shelving rock and sleep till the camp came up, when I had the tents pitched as soon as possible in the Dalli Gote and was very glad to get into bed, though I had had nothing to eat since "chota hazri." Dalli Gote is a lovely spot, there are no less than nine waterfalls opposite the camp, and the hill sides are covered with the most beautiful wild flowers, while the crags and cliffs all round are very wild and grand.

5th June.—Up very early, feeling seedy still, but started sharp for the head of the valley. The scenery is very grand, the cliffs are enormous. The air is cold and crisp, and the stillness so marked, that not a sound of a living thing is to be heard. Soon after starting, we got to a nice looking gote and spotted two bears, the upper one, which was the smaller of the two, was evidently being hunted by the other. I got an easy shot at the lower one, and bagged him : the other escaped before I could reload. After breakfast, we continued our way up to the head of the valley. The Shikary suddenly sighted two bears which came galloping down the nala towards us playing like a couple of dogs ; we watched them for a time, and then I got behind a rock to wait for them ; the leading bear had turned off and was making for the opposite hill ; I got a bad shot at her and broke her leg, and we had then to run along the snow to get another chance at her as she crossed the ridge. I got a running shot and rolled her over into the nala below, but she was up again and was attempting to cross a roaring stream as the third shot finished her. Meanwhile what had become of the second bear was the question. We ran back and saw him crossing over some deep snow : he was a long way off, but it was good practice, so I squatted down and had nine shots at him at long distances, and only hit him once, but lost him. Later on I got this same bear lower down the valley.

F. O. L.

(*To be continued.*)

The Obstacles to Home Timber-growing

Sir Arther Grant, *Bart.*, of Monymusk, Aberdeenshire, in noticing a review of the *Journal of the Royal Horticultural Society*, makes some interesting remarks on his experience in forestry. When old plantations were planted (he says), four pests of the forester did not exist in this (Aberdeenshire) part of Scotland—the rabbit, the squirrel, the Larch disease, and the lucifer match. Do what you like, it is very difficult to keep the rabbit entirely out of the plantation, and you must make up your mind to lose a proportion of newly-planted trees, and the trees are not out of danger for some years. When they are 25 feet high, or thereabouts, the squirrel attacks the Scotch Fir, eating the bark in spring on the sunny side. As a rule, he clears a patch perhaps 4 by 6 inches. From this the sap oozes out, and the winter wind snaps off the top, perhaps 4 or 5 feet from the tip; after this, your tree makes little progress. It is very difficult to see the squirrels in the Fir trees, and they are prolific little rascals. After killing perhaps 500 squirrels in a year, I find the damage the following year to be little lessened, and I have thousands upon thousands of promising Scotch Firs destroyed or grievously injured by them at the present moment. Again, when your Larches have been planted perhaps twelve to fifteen years, the disease begins to show, and in many places, at about thirty to forty years of age, they go "pumped" in the centre, whilst yet too small to have much timber-value. Silver Firs also are now very subject to disease. Lastly, we have the lucifer match. Never a year goes by but we suffer at Monymusk more or less from the recklessly careless tourist or labourer, who lights his pipe, wanders on, and if he starts a fire, makes himself scarce at once. Last year a great deal of wood and young plantation and moor in Aberdeenshire was destroyed in this reckless fashion. In Switzerland they have very severe laws about firing the woods. These are some of the difficulties which surround modern plantations from which the older foresters were free.

In regard to profit, the labour of ditching, draining, fencing with walls, planting, and caretaking was much cheaper in the old days than at present. There was some sale for thinnings, which were largely used for rails. Now wire fencing and iron fences have stopped nearly the whole of that outlet, and thinnings will not pay for cutting and hauling. Twenty years ago, Larch timber was selling at 1*s.* 6*d.* per foot. This year, I have known of some sold for 4*d.*, and the best price would be between 6*d.* and

9*d*., except possibly in some very exceptional position. The accessibility of a wood has, of course, an enormous influence on the price. Scotch Fir, again, was sold at Monymusk early in the century for 1*s*. 9*d*. per foot; 4*d*. would be about the price nowadays —of course I mean in large quantities. Put £100 into plantation nowadays, put £100 out to interest at 5 per cent., and for every £40 you get for your timber in sixty years, you will get £70 in the other investment, and you will not have the loss occasioned by rabbits, squirrels, Larch disease, and fire ; you will not have fences to keep up, or to employ men to destroy the vermin, and oftentimes to turn out your neighbour's cattle, which are busily destroying your young trees. I plant some 300,000 to 500,000 of trees yearly, but I know it is a poor investment, and I do it first as a family tradition ; second, to give shelter and improve the climate ; third, because it employs a very considerable number of people, both in summer and winter.

The old timber found in old castles was probably "natural grown," of very great age when cut, and placed in suitable positions for keeping. I have, on the contrary, plenty of beams probably 120 years old which are full of dry-rot, and much infested with the wood-beetle. I find the more beautiful and rare Coniferæ to be all perfectly unsuited to the climate of Monymusk. Some may do for ornament—none, apparently, for business.—(*Gardener's Chronicle.*)

Lord Lansdowne on the Forests of India.

One of the grievances of the people of India is the administration of the Forest Department, the native element contending that the Forest Department are the trustees, not owners, administrators, and not revenue earners, which gave rise, at the last Session of the National Congress, at Nagpur, to an interesting debate. The *congress* having made representations on the subject to the Viceroy, Lord Lansdowne referred to the subject in a speech at Mysore, in which his lordship said, "I will ask you to remember that not only here, but in all parts of this country, the Government of India has no desire to administer the forests except for the benefit of the population adjoinig them. It is our object that forest administration should be cnducted with the utmost regard to the comfort and convenience of the cultivators, but, unless proper measures are taken to protect the forests of India from destruction, the country as a whole will suffer greatly. In some parts of India, the injury already done is irretrievable, but where forests still exist, we are determined to manage them as trustees for the whole community, and nothing is further from our intentions than to encourage anything like arbitrary or oppressive treatment of persons possessing grazing rights *or otherwise entitled to the use of forest* products." *(Madras Mail.)*

Working the Circular Saw.

By M. POWIS BALE, M. Inst. M. E.; A.M. Inst. C. E.

Owing to the ever-increasing competition in the wood converting industries, to ensure a moderate return on invested capital, it has become necessary to economise in every possible way, and to reduce the working expenses to the lowest limit. If judiciously undertaken, and not carried to excess, a distinct saving in power and wood may be effected by the employment of thin gauge saws, this sawing, of course, *largely depending on the nature of the work*, and the value of the wood. The successful working of thin circular saws depends to a considerable extent on the skill of the operators, but there are certain points of construction and detail that are most important factors in bringing about this result, and those we purpose to notice briefly on the present occasion.

In the first place, the saw bench itself should be of substantial construction, and be kept in perfect order. The fence must be carefully fitted and be perfectly true, a fine adjustment screw can be recommended. The bearing splindle and saw collar should be accurately fitted, and kept in first-class condition. The saw must be correctly speeded; about 8,000 to 9,000 ft. traverse at the points of the teeth may be accepted as a standard. When the saws are ordered from the maker, *it is important that he be informed of* the speed that it is intended to run at, so that he can "compensate" or hammer the saw so as to properly allow for the increased expansion of the rim over the centre owing to its greater velocity. Many saws are not "compensated" correctly, and this is a fruitful cause of their heating and running from the line. As already mentioned, saws when running expand more at the periphery than at the centre, consequently they should be hammered "open" and uniform at the centre, so that when in work they straighten themselves and consequently run in a true line.

The number and shape of the teeth should be determined by the nature and hardness of the wood to be sawn, by the rate of feed required, and by the gauge of the saw. No absolute rule can be laid down as regards the number of teeth, as *the conditions of* working vary so much; some makers allow from one to four teeth for every inch in diameter of the saw according to the work required of the saw, the harder the wood the greater the number of teeth. It need hardly be said that the saw should be of the finest possible quality of steel, combining as far as may be toughness with hardness.

For very thin sawing, or for sawing valuable woods, a "ground off" or taper saw can be recommended, but this form of saw is unsuited for breaking down logs or heavy planks. In lieu of a ground off saw, a thin gauge saw fitted with a centre stiffener

is often employed. In this case the stiffener is a steel disc extending to about half the diameter of the saw, it is about three-sixteenths of an inch in thickness in the centre and is tapered down to a thin edge, the saw itself being tapered from the periphery of the disc to the teeth. For breaking down very valuable woods, where a frame saw is not available, a circular saw tapered on both sides and fitted with collars or stiffeners can be used.

It must be borne in mind that the thinner the gauge of the saw the greater in proportion will be the number of teeth required to turn out the same amount of work as a saw of thicker gauge, this arises from the increased liability of the thin saw to spring sideways and follow the grain of the wood.

Other very important factors in the successful working of thin gauge saws are the shape and uniform length, spacing, and gulleting of the teeth, the uniform sharpening and setting of the teeth, and the speed at which the wood is fed through the saw. It need hardly be said that the shape, number, and length of the teeth should be adapted to the nature of the wood, but this question is such a wide one that we cannot here give it more than a passing notice. The teeth should be of equal length, so that they all take their fair share of work, and the gullets should also be uniform, so that when the saw is at full speed it will be perfectly in balance, and the centrifugal force set up will be equal.

To enable saws of thin gauge to be run successfully, it is important that they be very carefully and evenly "packed." For this purpose we can recommend the employment of either two pieces of hoop iron or strips of hard wood of the length of the saw from the teeth to the eye, and of a width that will reach not quite flush with the top of the table; then take some flax or rope yarn end, lap it evenly round the strips from end to end till they are made thick enough to fill the packing space, and bear evenly and not tightly against the whole front half of the saw plate up to spindle; this will be found a better plan than ramming, as if the packing be tighter at one point than another, the friction on the sawplate is uneven, and it will often cause a thin guage saw to run wavy. End play on the saw spindle must be prevented, and care must be taken that the diameter and width of the driving pul on the saw-spindle are ample to permit the use of a driving-b will run the saw up to its full speed without slip, and c variation in speed. The belt must be kept soft and easy, and very evenly joined, so that there is no jump it over the pulley.

As we have before remarked, the thinness of the g which a saw may be safely run without "buckling" depe large measure on the skill of the operator, the selection of shaped tooth, and the proper set according to the nat wood being cut. The "packing" and sharpening of

also important matters ; in point of fact, to be really successful in working thin gauge saws, they must be kept in what may be termed scientific order. For speeding a thin gauge saw, it must be borne in mind they cannot safely be run so fast as a saw of thicker gauge, as they expand and heat more rapidly, and are more likely to become rim or centre bound and pliant in working, and will therefore run from the line. For a like reason, too rapid a feed of the wood must not be attempted, and the teeth must be provided with a sufficiency of throat space to allow of an easy escape of the saw-dust, and prevent clogging of the saw. No absolute rules can, of course, be laid down in this connection, as they must of necessity vary somewhat according to the nature of the wood.—(*Timber Trades Journal.*)

The 'Karri' wood of W. Australia as a Paving Material.

We have received from Messrs Temperley & Co., of 72 Bishopsgate St., a copy of their pamphlet on the subject of this new wood recently introduced as a material for wood-paving. It is the produce of the *Eucalyptus colossea* or *diversicolor* and is found near Torbay in W. Australia close to the port of Albany. The trees are very large, often giving boles of 150 ft. up to the first branch, and individuals have been met with that were 400 ft. high in all, as recorded by Baron Ferdinand von Mueller, K. C. M. G., the State Botanist of Victoria. The estates of Messrs C. and E. Millar were recently visited by Mr. Ednie Brown, the Conservator of Forests in N. S. Wales, who expressed himself as very much impressed with their value in forests of this and other species of Eucalyptus.

Messrs Temperley & Co. are anxious to find agents in India for the 'Karri' wood which they are selling in the form of planks at the rate of £7 nett per load of 50 feet. They think that prices at Indian ports ought to be not less than those at English

have never yet heard of 'Karri' being tried for building purposes in India. 'Jarrah' has been occasionally used ep but considering that our own good supply of Deodar, d Pynkado wood only barely finds a market, we should say Australian woods have not much chance at present against ionable pot and trough iron sleepers which are probably so d more on account of the facility of obtaining them than t of their being more lasting than wood.

THE

INDIAN FORESTER.

Vol. XIX.] April, 1893. [No 4.

A plea for Protected Forests.

Mr. Baden Powell in his Manual entitled "Jurisprudence for Forest Officers" has given it as his opinion that Protected Forest is not a permanent Forest Estate, that it only serves to prevent the rapid deterioration of growth where conditions are as yet undeveloped, and where permanent, *i.e. Reserved* forests, cannot be decided on ; and elsewhere in the same Manual he expresses the hope, if it be remembered aright, that Chapter IV of the Indian Forest Act will be expunged from any future edition of the Act which may be compiled for the whole of India and Burmah. It is doubtful whether his suggestion will ever be carried out : should, however, such a step be contemplated, Government, it is hoped, will pause before taking it, as climatic and other conditions vary so considerably on this vast continent that a universal code would scarcely be applicable to every locality.

In all Provinces where forests depend on a rainfall, Reserves undoubtedly are desirable ; but what about those localities where rainfall is almost an unknown factor, (at any rate for all practical purposes) and where sylviculture is dependent entirely on river floods. A part of India exists where such a condition of things prevails, and probably it will not be out of place, and may be of interest, to describe some of these conditions and show how the maintenance of forests is affected thereby, and how the requirements of Chapter IV of the Act seem specially adapted to meet their case.

The forests under notice are situated along the river on alluvial land and extend along both banks for 150 to 200 miles, not however forming an unbroken chain of vegetation, for here and there Government waste and Zemandari property intervene. As may be imagined, this alluvial soil suffers considerably from exposure to the wearing action of the stream. In the cold weather (November to February) the river is low ; nevertheless active in eroding its banks. At this period, the erosion is gradual, and its progress can be both observed and heard ; in the stillness of the night the falling in of the overhanging fragments of a bank are distinctly audible like reports of heavy cannon.

During May, the waters begin to rise in vast volumes, soil is rapidly eroded, and belts of jungle two and three hundred yards deep containing ; *Populus euphratica*, *Acacia arabica* and *Tamarix gallica* are rolled over and over into the stream.

A little later, the river overflows its banks, and floods the country within the limits permitted by the Irrigation Department; and when it falls, generally in September, it will often be found to have cut a new channel for itself. This "erratic wanderer" at times makes a detour bisecting a large forest and leaving a wide gulf between the two parts. At another time, a slice removed from one forest is left as it were as an accretion to another on the opposite bank, or if the land opposite be Zemindari or Government waste it is claimed by either of the latter. In this manner, the riverside areas are constantly fluctuating, and diminishing, and not unfrequently vanishing.

In view of such ever-changing and unstable conditions, the question arises whether the constitution of Protected instead of *Reserved Forests in similar circumstances is not desirable*, and whether, as a matter of fact, these very conditions in consequence of the value of the property, do not make it incumbent on the Legislature to provide for the formation of a class of forest which can cope with these changes. The provisions of Chapter IV. seem to meet the case entirely.

A Reserved Forest is created after elaborate and refined demarcation and settlement under the auspices of a Special Officer at considerable expense, and much time often elapses between the notification under Section 4 and the final one under Section 19. Four and five years have been known to elapse in some instances. In the interim, with such conditions existing as described, it might be found, when the notification under Section 19 came to be made, that the greater portion of the forest had disappeared, or that it was entirely *non est*. The forests which now exist are all Reserves, and were made so under Chapter V, Section 34 when the Forest Act came into force in 1878.

A Protected Forest, on the contrary, can be formed by one sweep of the pen and without the aid of special means. A Forest Settlement Officer is not necessarily needed to demarcate and enquire into it, *vide* Chapter IV, Section 28, clause 3, and the important feature is, that exploitation in it can commence immediately after notification. It can be worked quite as efficiently as a Reserved Forest, the only difference being that the working plan would require Government sanction, *vide* Chapter IV, Section 29. But to create a permanent structure on land which is *ipso facto* temporary is rather unreasonable. The folly of such a proceeding was forcibly illustrated recently when important defence works were erected on the bank of the river one season, only to be swept away the next; and yet, indeed, some authorities would construct permanent forest estates to be swept away in like manner. The removal of Chapter IV from the Act would mean nothing more than this.

In view of such ever changing and unstable conditions as described, it may well be asked, how came extensive forests to be formed at all, and if they last only a few seasons, what value can the growth in them be from a forest point of view ?

The facts are that formerly the river floods were allowed to spread over the greater part of the country, except into towns and large villages which were surrounded by embankments, silt was distributed uniformly over a wide area, and the bed of the river followed a serpentine course merely flowing over the country as water will if made to run gently over a tolerably level surface. It sought, at intervals of long duration, a new channel as all inundation rivers will ; but this channel was not subjected to any deep scouring out process, as a more rapid and direct flow, under similar circumstances, would cause.

A dense forest, for instance, was not carried away bodily, its obstruction rather causing the river to break and form an island or make a wide detour, round it.

Erosion, under such conditions, though of course present, was imperceptibly felt, and the changes wrought were so gradual that canopied forest had time to form and establish itself.

The drawbacks, however, attending a river whose course was liable to fluctuate in this manner and whose floods meandered here there and everywhere, were agricultural uncertainty, insecurity of life and property, and general unhealthiness of the District. To remedy this state of things, the P. W. D. erected "bunds" on either side of the stream and substituted a system of irrigation by a network of canals for the District which have undoubtedly benefitted the country ; but while all other interests have been served, the forests undoubtedly have suffered. These forests outside the "bunds," for instance, are all drying up, artificial irrigation as it is found, is too expensive to maintain them, and, in a few years, the place thereof will know them no more ; but it is with regard to those within the bunds that it is sought to invite attention.

The constantly occurring changes in the forest areas here as previously explained, which are almost kaleidoscopic in their character, have only begun to be be marked since the development of the "bund" system. The embankments often run through a forest or sometimes form an outer boundary of a forest on both banks. The river, in the cold months, is a narrow channel between. In the hot weather, however, it rises and forms a mighty roaring flood whose waters get heaped up against the embankments, some times so high as to spill over them. The banking up of the waters contributes, as is natural, to the more rapid deposition of silt at the sides than in the centre of the stream where the current is rapid. The surface of the land at the sides therefore gets quickly raised ; but the bed of the stream itself is slowly being raised too, and when it has risen so high that the water is no longer able to be retained in the same channel, the river swerves and seeks a new course scouring its way through thickly deposited silt and jungle, and clearing everything before it as chaff before the wind.

It may be gathered that the time arrives when this "wanderer" is under the necessity of abandoning the new channel thus formed; it then leaves a fresh alluvial deposit in place of the canopied forest which previously existed. This lasts for about seven or eight or perhaps ten seasons, when the stream returns probably to its old course to perform the same operation of destruction as before; but of course on a much minor scale. In this way the river, being hemmed in, dances about from bank to bank within its specified limits, affording no time for the formation of any large timber trees. A complete change, therefore, is taking place in the character of the forest, which only the Forest Officer sees, and the disastrous effects of which it is difficult to make others fully understand. What is needed of course is, to give the river space for far 'greater expansion than it at present enjoys' this will dimish its velocity and force, and mitigate the rapid changes that now occur. In the interests of the public weal, the "bunds" must stand, otherwise from a forest point of view they ought, of course, to be done away with altogether. As regards the use to which these temporary forests can be put, it may be mentioned that they yield poles and rafters and a large quantity of firewood which is utilized as fuel for Steamers, for the Railway Locomotives, and for various mill industries.

Tamarix gallica and *Populus euphratica* seedlings are to be seen in countless thousands on a bank which has been recently abandoned by the river, and in less than half a dozen years a first coupe may be made from them. As an instance of the rapid reproduction of Tamarisk, coppice shoots, 19 months old, have reached a girth of 5¼", and instances of girths of 3" and 4" are not uncommon.

The question of large timber, however, is one of very serious importance, for a considerable income is derived from this source, which, if the present irrigation plans continue, will entirely disappear in a few years.

G E M.

Injury by Insects and the value to Forests of the Enemies of those Insects.

The more we gain an insight into the fact that not only are the means at our disposal to prevent injury by insects quite inadequate, but also that the artificial working of the forests may in itself favor an excessive reproduction of certain insects, so much the more we must acknowledge the necessity of an ability to recognize the enemies of such insects and of ascertaining in what way they are helpful. The enemies of an insect may be divided into external and internal enemies, and of the former, bats are amongst the most important. These animals are indeed seldom

mentioned as being destructive to insect life, but on account of their avidity and owing to the fact that they feed at night and therefore on insects which are not exposed to destruction by birds, they become of the greatest consequence. Many of the insects most harmful to forest growth only fly by night and are protected during the day by their color which is assimilated to the bark of the tree on which they feed, and it has been frequently noticed that excessive reproduction of such insects is followed by an abnormally large gathering of bats in the forests affected. As bats only feed on the wing, they can only destroy full grown insects, and do not affect in any way the eggs or immature insects of any species; on the other hand they devour enormous numbers of mature females, which, as we will show later on, seem to be protected against the ravages of birds, and thereby prevent the birth of thousands of caterpillars and consequent harm to forest growth. It is an error common to those who do not observe, to assume that the number of bats is insignificant, and that therefore their influence on insect life is small. This however, is not the case: the number of birds is generally overestimated because they are for the most part diurnal in their habits and also noisier than bats. In point of fact, bats are in most localities more numerous than birds. Other insect-eating animals are, from the forester's point of view, of much less importance than bats; they are probably as ravenous as bats, but as they feed on immature insects whose chance of producing young is much smaller than that of the mature insect, the good they effect is not so marked. Insectivorous animals are of much more importance in Agriculture than in Sylviculture, for in the former, the injury by insects is mainly accomplished by the grub of the Cockchafer etc. Amongst other Mammalia which feed on insects may be mentioned the fox, badger, martins, rats, mice and rodents; these animals are mentioned only to complete the list of other insect enemies, but they have no influence whatever on the numbers or increase of insect life.

We cannot, however, pass over the value of birds in so cursory a manner. It is a well-known fact that many species of birds feed themselves and their young on insects and caterpillars, which are harmful to vegetation; and we all admit that the presence of insectivorous birds in a garden is a subject for congratulation. In agriculture, birds play a part of some importance in preventing the excessive increase of insect life; the almost universal destruction of hedges which has taken place during the last few years was predicted as certain to be followed by an enormous increase in insect life. In point of fact, although birds were driven to find shelter at a greater distance from cultivation, there was no marked increase in insect life discernible. The value of birds as insect enemies is often overrated. For instance, the number of insects varies enormously from year to year; the number of birds remains fairly constant; it is evident therefore that the ordinary number of birds cannot produce much effect on an abnormal number of

insects produced in any given year. The answer to this argument is that birds flock to the locality where insects are abundant; but this is not by any means definitely proved; observations have been made by trustworthy naturalists of a most contradictory nature. It must also be remembered that many insects are more or less perfectly protected against birds and that amongst these are many of the most harmful. Many experiments and observations are recorded in reference to the reasons of birds for avoiding certain insects, and to discover why some insects are devoured by certain species of birds and not by others. It is probable that insects which are so avoided are poisonous to the species avoiding them; but *Zenzera Aesculi* is avoided by all birds, who show the greatest anxiety in the presence of this moth. Butler attributes this astonishing fact to the coloring of the wings of this insect; and it is remarkable that a similar coloring is present with the "Nun" which is seldom or never attacked by birds, showing that in the latter instance the coloring is purely protective. The author here enters on a long dissertation on the numbers of individual species of birds in Europe, and values each species separately with regard to its power of destruction of insect life. These details are not of great practical importance for an Indian Forest, so long as we are acquainted with the result arrived at, which is briefly, that in spite of all the good done by birds, their influence on insect life is not sufficient to prevent any abnormal increase thereof. Such an increase is provoked by favorable climatic influences alone and superabundant insect life is destroyed by adverse climatic or other influences alone. A single fruit tree, an isolated patch of forest, a garden, may indeed be benefited by the action of birds but in large tracts of forest they have no practical effect. In fact in the commotion raised in the last few years regarding protection of birds, too much stress has been laid on their value as destroyers of insect life. The great insect plagues which have devastated large areas of forest have been stayed by parasites and climatic influences. Ratzeburg remarks that the *ichneumon* flies have more value as insect destroyers than birds, and Pfeil writes that if the Ichneumonidæ could sing, much useful sympathy would be diverted to their species. In this, all must be agreed that in such discussions a hard and fast line must be drawn between sentiment and fact, and whilst bitterly regretting the wholesale destruction of birds and rejoicing over the protective laws passed for their benefit, it must at the same time be acknowledged that their utility has been much exaggerated.

If birds have, owing to the fact that they are so agreeably remarkable, succeeded in attaining an unmerited position in regard to their capabilities of destroying insect life, this cannot be said to be the case with lizards. The number of species is indeed small, but the aid afforded by this animal should not be undervalued as the number of individuals is very large. In sunny spots in forests there are often more lizards than birds, but it is difficult to see

them, so secretive are their habits. Moreover, the number of lizards depends much on the locality: for instance in Northern Italy, lizards are probably ten times as numerous as birds; in South Germany the latter are much more common. The lizard does not go far from its home, but as its beat is restricted, so its search for prey is extremely careful: every leaf and twig is inspected. The food varies with the season of the year and is composed of harmless as well as harmful insects; but although in certain circumstances lizards may be useful, yet their action can have no more practical effect than that of bats and birds. Amongst amphibious animals, frogs and toads feed on insects. The stomach of the common frog is often full of insects both harmful and harmless, but frogs do not as a rule frequent forests, with the exception of the tree frog which is comparatively rare in Europe, though it is apparently frequent in the tropics. In Japan, for instance, tree frogs appear to be more abundant in certain localities than birds.

Vertebrate animals, as enemies of insect life, perform, however, an insignificant *rôle* compared to that filled by the invertebrata. Most of these latter belong to those classified as *external* enemies but there are a few which can be reckoned as *internal*. Amongst others, the ants, representing an important factor in the forces of nature, rank as enemies to insect life. Ants have indeed been artificially introduced into forests devastated by *Cnetocampa pinivora*, with the result that though the ants killed such larvæ as came in their way, they ultimately left the forest. Such experiments are useless, unless the relationship of ants and other insects are better proved. It has been remarked that ants live in the same trees with all kinds of insects and caterpillars and do not molest them, and the conclusion has been arrived at, that ants in ordinary circumstances do not prey on insects, but only kill such individuals as may be sickly or are found in abmormal circumstances such as fallen from trees, &c. If this were not the case it is probable that ants would so increase that in a short time they would dispose of the rest of the insect world. The term 'ordinary circumstances' must of necessity have only a limited application, but the conclusion to be arrived at is, that ants do not seriously affect insect life so long as it is vigorous, but should the insects be weakened by climatic influences or other causes, this is taken immediate advantage of by the ever ready ant. Mention may be made of certain wasps which prey on insects, but they have no special importance from a forest point of view as their food consists equally of harmful and harmless insects. Some of the Hemiptera are also useful as feeding on caterpillars, especially *Tropicoris rufipes*; in Europe, however, the Hemiptera are of little significance although they are apparently of more importance in tropical countries. The same may be said of many other insects such as grasshoppers, beetles, etc., etc. It is not doubted that such insects do feed on insects harmful to forest growth, but they do not confine their exertions to such species. Amongst the many thousands of species of insects to be found in

European forests, scarcely 100 species are harmful and only about 20 are capable of causing widespread devastation ; it is therefore evident that the action of invertebrate enemies to insect life cannot be compared with that of the internal enemies of insects. These internal enemies are divided into animal and vegetable life, and to understand the subject correctly, some old errors and absurdities, up till now believed in, must be abandoned ; and although it is not the aim of this paper to abolish these beliefs, their untruth must be exposed where necessary. For instance, Ratzeburg arrived at the extraordinary conclusion that the parasites of the *Ichneumon* and *Tachina* only affected unhealthy caterpillars; so that they were of no utility as destroyers of insect life. This has been proved to be utterly false, as infected caterpillars after being operated on have produced healthy moths ; moreover, in spite of the presence of parasites, moths have been formed before and after the development of the perfect parasitical insect. It is astonishing to find during the prevalence of an epidemic, that hardly any caterpillars contained parasites, and on the other hand to observe that it was not found possible to inoculate with fungoid growth such insects as already contained parasites. The explanation of this need not be entered upon here ; it follows on biological laws and is merely mentioned to show that animal and vegetable parasites do not work against each other and that it cannot be taken as an absolute fact that parasites only attack either sound or unsound individuals. The slow increase of parasitical insects has been brought forward as a proof of their low value as insect destroyers. In the first year of abnormal increase of harmful insects, parasites cannot, it is true, proportionately increase ; the increase of the parasite must follow and cannot be coincident with the increase of his supporter ; but in the second year the proportion of deaths from parasites largely increases, whilst in the third the insect on which it preys is practically exterminated. The following statistics on this subject may may be interesting. During a period when *Gastropacha pini* was present in normal numbers, only 2 per cent were infested by parasites; whereas 26 per cent were infested during a period when the numbers were commencing to increase. At the end of a plague of these caterpillars it was found that of one hundred specimens, 32 were suffering from an epidemic and 54 from parasites. The great value of the *Ichneumon* and *Tachina* is that they confine their action to a single or a few species. The author here gives a paragraph on the question of the frequency and death of the *Ichneumons*, he finds that the frequency of the parasite rises and falls with the frequency of the carterpillar. He points out that this relationship does not exist between the vertebrate enemies to insect life and their insect food, from whence it happens that birds may be able to exterminate a species that has been almost destroyed by disease, or adverse climate, whereas they would produce no effect in the numbers of the same species when abnormally frequent. The parasitical insects are enabled by their power of producing a

very numerous progeny, to adapt themselves easily to an increase in number of the insects which support them. It has been proved that one larva of a butterfly can afford nourishment to several thousand parasites and as we may assume that all the parasites found in one caterpillar are the offspring of one mother, some idea of the fecundity of these insects may be obtained. Although it has sometimes happened that parasitical insects have directly prevented an abnormal increase of a particular species of insect, this is not generally the case: as a general rule the plague of insects is terminated by an epidemic. We have already pointed out that the great value of parasitical insects depends on the fact that they confine their attacks to harmful insects; and in regard to fungoid growths this is still more marked. Most epidemics occur amongst larvæ when these are produced in abnormal numbers, and in most instances in the case of harmful insects, with one notable exception however, that of the silkworm. When it was first discovered that insect epidemics were due to fungoid growth, many different maladies were distinguished which were, however, finally discovered to be different forms of a few fungi. Pasteur for instance only distinguishes four forms of the silkworm disease. It will be sufficient here to remark that the same mistake has been made in reference to fungoid disease of insects, as was made about parasitic insects; it was thought that the disease only attained importance when insect life was superabundant. It was recognized that the epidemic in conjunction with parasitic insects brought to an end the devastation wrought by insects, but only careful observers noted the spread of the epidemic before the abnormal swarming of the harmful insects had reached its zenith. The result of the coincident swarming and plague was that the former was prolonged so that it only reached its period of greatest activity when the fungoid germs had also reached the highest reproductive power. In one locality, the percentage of plague stricken caterpillars rose within 10 days from 15 to 51 per cent., a proof of the destructive nature of the disease. There are, moreover, certain diseases which are hereditary, and which, as it is known in the case of the silkworm result in feeble and deformed offspring. At any rate, the effect of such a plague in harmful insects is very deadly, and before a species can recover itself, the forest receives a well earned rest for its recovery. The result of observations made on insect epidemics shows that the idea of preventing the devastation by artificially inducing disease is worthy of attention. The author here devotes some paragraphs to the question of cultivation of bacteria, quoting suitable insects for this purpose. He is certain that much more effective results are to be obtained in this manner than by the wholesale protection of birds which has no effect whatever. The object of the paper is to direct observation and enquiry into the points discussed and any facts which prove or disprove the statements made, will serve a useful purpose in clearing up the subject.

DR. ADALBERT SEITZ,
GIESSEN.

Influence on the vegetation of a forest of the removal of dead leaves from the soil.

Under this head, experiments extending over a period of several years have been carried out by the Prussian Forest Experimental Station, the results of which have recently been communicated to a contributor to the *Révue des Eaux et Forêts* by the Director of the " Station," Dr. A. Schwappach.

The experiments were made in two forests of beech, situated in totally different localities, one being in hilly ground near Tréves at an altitude of some 1,800 feet and on a soil of poor or medium quality, the other being near Stettin on a fertile diluvial soil with a sub-soil of marl.

In the first case, the areas experimented with were perfectly divided into five equal portions, one portion being allowed to remain untouched; from the second dead leaves were removed every year; from the third every two years and from the fourth and fifth every four and six years respectively.

In the second case, the areas were divided into two portions, the ages of the crops on the three different areas so divided being different. From one half of each area, dead leaves were removed annually, the other remaining untouched.

Tables are appended giving the perodic increase in volume of the crops on each sub-division of the area; in the first case for five periods of six years and in the second for two periods of nine years. These tables show that in the forest growing on poor soil, there was an average loss of growth in the volume for the last three periods of 51 per cent when the dead leaves were removed every year
,, 40 ,, ,, ,, ,, ,, ,, ,, 2 years.
,, 22 ,, ,, ,, ,, ,, ,, ,, 4 ,,
,, 9 ,, ,, ,, ,, ,, ,, ,, 6 ,,

In the crops growing on good soil, the loss due to the annual removal of dead leaves during a period of 18 years was

25 per cent in the crop aged 50 years (in 1873).
21 ,, ,, ,, ,, 77 ,, ,,
11 ,, ,, ,, ,, 74 ,, ,,

These figures would seem to show conclusively that the removal of dead leaves is more harmful on poor soils than on fertile ones, that on the former the practice may diminish the production of wood by more than one half. Also that the influence of the removal of the leaves is greater, the more frequently and the longer the practice is continued.

Dispersion of seed by birds.

(*From the Révue des Sciences naturelles appliquées*).

Many birds travel more than 400 metres a minute and are thus able in a very short space of time to carry to distant regions the seeds of plants on which they feed.

Mr. Pistoni of Messina has been making observations on this subject in Sicily, where plants peculiar to northern climates are to be found alongside the indigenous plants of the country. On this island, birds seek for and disseminate chiefly the following species :—

Birds.	Plant on which they feed.
Corvidæ : Corvus frugilegus, Cornix monedula. Picus Graculus, Garrulus glandarius.	Fruits of Prunus avium. Olive. Fig, Date. Dwarf palm, and Cornus Mas.
Oriolus Galbula.	Phillyrea variabilis. Prunus Cerasus.
Sparrow and Chaffinch.	Arbutus Unedo. Morus nigra and alba. Linum usitatissimum and strictum.
Canary (Serinus hortulanus).	Cruciferæ. Koenigia maritima.
Emberiza Schœniculus. (Rosy Ortolan).	Phalaris Canariensis. Setaria italica. Panicum miliaceum.
Thrushes (Turdus pilaris, torquatus).	Vaccinium Myrtillus. Myrtus communis. Rubus discolor and tomentosus.
Hawfinch (Coccothraustes vulgaris.	Mespilus germanica. Cratœgus Azerolus.
Turdus viscivorus.	Mistletoe.
Warblers. Sylvia hortensis, cinerea, atricapilla, conspicillata.	Figs—cultivated in wild form.
Nightingale. Philomela luscinia.	Strawberry.
Robin. (Erithacus rubicola).	Elders. Sambucus nigra and Ebulus.
Tomtit. (Parus major).	Arbutus Unedo.
Marshtits (Parus biarmicus, pendulinus).	Calamagrostis, Arundo and Phragmites.
Wrens (Regulus ignicapillus, cristatus).	Juniperus oxycedrus.
Accentor alpinus and modularis.	Briars.
Doves (Columba palumbus).	Leguminosæ and oaks.
Quail (Coturnix. sp. sp.)	Phytolacca decandra.

Several curious examples of this method of disseminating seed are quoted. From the Botanical Garden at Palermo the small bulbs of *Oxalis cernua* were unearthed by birds and in a short time sown in all the fields in the neighbourhood. Through the agency of wild pigeons, two oaks (*Q. Macedonica and Ægilops*) are now growing in certain localities of Sicily, and Sardinia.

Seeds swallowed by birds germinate easily after having been digested. In Sicily, where many quail are killed, it is the custom to remove the contents of their stomachs and plant them in pots by which means rare and foreign plants are often obtained.

The Palmyra Palm.

The Inspector-General of Forests has recently sent the following Circular letter round to Conservators.

"I would feel much obliged if, in consultation with your 'Divisional Officers, you would furnish me with authentic information regarding the occurrence of the Palmyra Palm (*Borassus 'flabelliformis*) in your Circle; and whether it is plentiful, common, 'or rare. It is stated that in some districts the fibre produced by 'this plant at the junction of its leaves is less developed than in 'others, while in some localities it is entirely wanting. This, I beg, 'may be specially noticed and recorded."

Report on the effects of the late frosts on vegetation in Hongkong.

The unprecedented cold weather which the region about Hongkong was recently subjected to, calls for some notice to be taken of it, therefore I have the honour to submit a brief report which it may be considered useful to put on record. Records of experiences of meteorological phenomena such as we have just had, besides being of passing interest are so frequently of use in practical dealings with various subjects, that for this reason opportunities to record unusual phenomena should not be neglected. It does not, however, come within the province of this department to go much further into the meteorological aspects of the subject than is demanded in connection with its injurious effects on vegetation.

After a period of ordinary Hongkong dry, cool weather, rain fell on the 13th January and continued daily up to the 16th instant. In the Gardens, at 300 feet above sea level, the following quantities of rain were registered with a Glaisher's rain gauge :—

January 14,	·14
,, 15,	·35
,, 16,	·46
,, 17,	·45

On the 15th instant the temperature fell in the afternoon to 39° Fahrenheit, thermometer at 350 feet above sea level. On the 16th, at 9 A.M., it stood at 35°. On the 17th the thermometer stood at 31° at 9 A.M., which was the lowest temperature observed at the Gardens. During this period the sky was overcast except for a short time about noon on the 17th, but on the morning of the 18th it was clear and the sun shone brightly throughout the day, the temperature having risen to 43° at 4 P.M.

Unfortunately there are no official records of temperature at Victoria Peak, 1,818 feet above sea level, but, by such information as could be obtained from private observers in the hill district and observations made here, it seems that the temperature must have fallen at the summit to about 25° or 24° F.

On the river at Canton, and *en route* between this port and that place, low temperatures were recorded in the reports of the steam-ships *Powan* and *Honam*. They give—

January 16th at 1 A.M. 23° about 28 miles below Canton.
,, at 10 A.M. 26° about 85 miles from Hongkong.
,, ,, at 1 P.M. 25° at Canton.
,, ,, 18th at 10 A.M. 28° about 25 miles from Hongkong.

On the peninsula of Kowloon the cold appears to have been greater than in Hongkong, ice was seen on pools of water in the roads within 50 feet of sea level, and at the Kowloon Docks ice was observed at the bottom, 30 feet below sea level, of an empty dock.

Since the Observatory records began in 1884 the temperature has not fallen, until now, at the Observatory, below 40° F. I remember on one occasion, I think about 17 years ago, ice was found at Victoria Peak, but there is no record within me experience, which extends back nearly 22 years, when ice was observed below 1,700 feet altitude.

The continued low temperature combined with fall of rain from an apparently warmer stratum of air above resulted in the formation of ice varying in quantity from a thin coating on the upper leaves of pine trees growing at 300 feet above sea level to a thick encasement of perfectly transparent solid ice of 5½ inches in circumference on the blades and bents of grass at the summit of Victoria Peak. The grass bents themselves, which were the foundation on which the ice accumulated, were not more than an eighth of an inch in diameter, yet the formation of ice was so gradual that with the enormous accumulation of ice which became its own support, the bents retained their natural upright, or but slightly pendent position. These large accumulations of ice were on the windward side of the hill where rain drifted, but even on the lea side the average coating of ice was about 3 inches in circumference.

Evergreen shrubs and trees carried on their leaves solid coverings of ice ⅜ of an inch in thickness. The great weight of this ice caused the branches of trees to assume a pendent form, the strain in many cases causing the limbs to snap off with a crash. All vegetation throughout the hill regions of the Colony was thus covered with ice, as were also most other objects. Telegraph and telephone wires from Victoria Gap upwards were covered with ice ⅝ of an inch in thickness, and, in addition, carried icicles as much as 3 inches in length as close as they could be packed side by side. This caused many of the telephone wires to break, and the iron post at Victoria Gap which supported them was snapped off a few inches above the ground.

The windward sides of the walls of the look-out house at the Peak were from top to bottom covered with perfectly transparent ice ¾ of an inch in thickness.

All the hills on the mainland and Lantao Island were likewise white with ice, one of the hills (3,147 feet) of Lantao having what appeared to be snow for some few hundreds of feet down from its summit. As early as the evening of the 15th January, the summit of Taimoshan (about 3,300 feet) on the mainland had assumed a a whitish appearance, presumably from ice or snow.

The effect of the extremely low temperature on vegetation has been disastrous. The damages in the Gardens consist chiefly in the injury or destruction of leaves, but some plants are quite killed, these being natives of much warmer regions than Hongkong. Many of the decorative plants which were not killed will be months before they can regain their ornamental appearance.

Every possible precaution was adopted to minimise the effect of the cold. The plant-houses, which are provided with screens merely to produce shade, were all matted in and the roofs covered with straw. In spite of these precautions, however, many plants suffered very severely.

In the orchid-house, which was covered with mats and straw, all our best orchids have suffered very greatly, many being entirely killed while others were so much injured that, even if they survive, it may be some years before they regain their previous luxuriant state. A healthy plant, received from Calcutta several years ago, of *Dendrobium aggregatum*, is apparently killed, while plants of the same species growing by its side, and also others on trees where they had no shelter, which I collected 10 years ago on the Lo-fan mountains, about 60 miles from Canton, have escaped unharmed. This seems to show the capability of the plant in adapting itself to colder regions than it is generally found in. In ordinary winters the temperature is too low for many kinds of orchids and other tender plants.

The highest point of the Gardens is 320 feet above sea level, the lowest part 175 feet. Some plants of the same kinds which were damaged at the upper portions were uninjured at the lower parts of the gardens.

Of exotic trees planted on the hills *Albizzia Lebbek*, *Aleurites triloba* (candle-nut-tree) and *Eugenia Jambos* (the rose-apple-tree) had all their leaves killed at and upwards of 600 feet above sea level. Trees of the rose-apple at about 800 feet altitude have been entirely killed.

At 600 feet altitude indigenous plants began to be affected, the injuries increasing with higher altitude until at about 900 feet when the extreme limit of low temperature which some plants could bear was reached, and death ensued. Most of these are tropical plants of which Hongkong, Formosa, the Luchu Islands in the Far East, and the Sikkim Himalaya in India are the northern limits of the geographical area from whic they have been recorded. Of the plants killed or injured, *Ficus Harlandi*, Benth., *Gordonia anomala*, *Spreng.*, and *Garcinia oblongifolia*, *Champ.* are known only from Hongkong. Although many of our indigenous plants have not been yet discovered elsewhere, it is to be expected that when China is better known they will be found over a larger area than the restricted one of this island. The fact of the above named plants having succumbed to the late frost indicates that when they are discovered elsewhere they will be found southward of Hongkong.

Considerable damage to vegetation seems to have been caused about Canton where the alluvial lands are highly cultivated. The Reverend Dr. B. C. HENRY, in a letter dated 26th January, informs me that "The destruction of vegetation about Canton has been very great. The banana plantations "are ruined, and

the bamboos have suffered. The *Aleurites triloba* look all shrivelled up, while "*Begonias*, *Euphorbias*, *Crotons* and scores of others are simply destroyed." What Dr. Henry reports indicates severer weather at Canton than here, as is proved by the reports of the steamers above referred to. *Aleurites triloba* leaves being shrivelled up at Canton, while they are here at 300 feet altitude uninjured, but at 600 feet here they are affected, and completely destroyed a little higher up the hill.

The People's Tiger.

In the People's Park at Madras has lately been incarcerated a tiger which was captured in the forests of Tinnevelly by Mr. C. Dupré Thornton. The method employed was a cage made of palmyra rafters and iron bars, with a trap door, and a separate chamber which contained the bait—a goat. The following extract from the *Madras Times* will be interesting :—" Yesterday I paid ' him a visit. He knew his old master at once and rushed at the ' bars in a most affectionate way which I was accustomed to ; but ' the bystanders, who didn't know his tricks, fled in alarm. He ' is as savage and surly as ever. In the day he disdains to eat any ' meat, but at night he is forced to eat. His rations are 25 lbs. ' of meat a day, or about a goat and a half. The old keeper relates ' that he was very savage when first let in. He jumped with one ' bound to a window, near the ceiling, but the bars stood firm, and ' stripes was *sold*. For two or three days he bounded backwards and ' forwards in his new home, refusing to eat anything, and flying ' at the bars when anyone came near. It will require years of ' imprisonment to tame his proud spirit. He wants a mate very ' badly, as the tigress in the Zoo is old enough to be his grand- ' mother. Perhaps some of your readers may be able to catch a ' tigress in the same way as I caught the tiger, and send her up to ' Madras."

Roadside Arboriculture in Bengal.

Mr. C. F. Worsley, Magistrate of Monghyr, has drawn up the following report regarding the system of planting trees followed by him, when he was in charge of the district of Mozufferpore, and the Government has directed that it be circulated to all district officers and district boards :—

"When I first commenced the system of planting trees along 'the sides of roads in Mozufferpore district in the year 1877, I 'adopted the plan which, I believe, is usually followed by inexpe-'rienced amateur planters, of working through contractors, and 'allowing them to plant very young trees or to raise them from seed 'in the spots where the trees were intended to grow up. Each of 'these young trees or seedlings required to be protected by a gabion 'or bamboo fence, and it was soon discovered that the expenses of 'repairing or renewing the fences and of supplying water to the 'young trees in the hot season were more than the District Road 'Fund could conveniently bear. I accordingly tried the experiment 'of raising young trees in nurseries from seed sown either in pots or 'in the open ground, and of planting them out along the sides of 'roads when five or six feet high. It having been found in practice 'that the young trees so raised in pots succeeded best, this system 'was generally adopted in Mozufferpore from the year 1880.

In my report No. 99, dated 6th February, 1880, for the Road Cess year 1878-79 (published in pages 1471-1479 of Part II of the *Calcutta Gazette*, dated 29th September, 1880), I described at some length the operations of the Mozufferpore Road Committee in connection with the planting, and the subjoined extracts will explain the advantages of their system :—

"On all other roads the trees are fenced with strong bamboo gabions, six feet in height and two feet six inches in diameter, made on one uniform plan, and built round the tree when planted in the following manner :—

"Five whole, not split, bamboo posts eight feet in length and not less than one and-a-half inches in diameter, are sunk in the ground to a depth of two feet at equal distances from each other, and a radius of 15 inches from the stem of the tree. Four pieces of split bamboo are then placed between the posts, and split bamboos are woven in basket fashion to a height of six feet, the last six inches being passed through loops in the bamboo posts to prevent travellers removing and untwisting the basket-work, which was a common and very mischievous practice, and one that caused continual labour and considerable expense in repairs. I may add that the system now adopted has been absolutely successful in preventing such mischief and injury ; as, although easy to twist the split bamboos through the loops when green, it is most difficult to remove them when they have become dried and set.

Nursery Gardens.—Two nursery gardens have been established during the last Road Cess year 1878-79—one at the dak bungalow in Mozufferpore, the other in the District Engineer's grounds. The formation of nursery gardens was rendered necessary for several reasons, amongst them the following :—

"(1). The difficulty experienced in obtaining young fruit trees of even inferior description.

"(2). The policy of planting none but good varieties and descriptions of fruit trees, so as to ensure eventually from the sale of the fruit a handsome return for the outlay and expenditure incurred in planting and maintaining them.

"(3). To prevent injury in transplanting trees with tap roots such as *Artocarpus integrifolia*, *Bassia latifolia*, and *Dalbergia Sissoo* by raising them in pots, it having been found by practical experience most difficult to transplant such trees satisfactorily. Experience has impressed the necessity of using pots for all future nursery operations as being eventually a safer and more economical way of raising and transplanting young trees than in and from the open ground. After much care, time, and expense have been laid out and incurred on the young trees in the nurseries, it is very disappointing to find them dying a few days after being transplanted, in consequence of injury to tap roots, and here I would observe that it is very inadvisable to plant out any trees less than two years old. The cost of tending, watering, and maintaining them is much less in the nurseries than when they are scattered over many miles

of roads, and as the existence of a bamboo fence such as is used in this district is three to four years by the time it is worn out, its need is no longer required, the trees being five to six years old, and strong enough to do without such protection. We have now in the nurseries 14,112 well grown young trees, which will suffice for about 80 miles of road, which is about the annual average length of avenue planted in this district."

I may mention that the pots in which young trees are raised should be buried in shallow trenches, each trench being long and broad enough to hold 400 or 500 pots placed as close together as they will stand in parallel rows. The rims of the pots should be slightly below the level of the surrounding ground, so that they may all be easily and cheaply flushed with water every two or three days during the hot season from an adjacent well. Between the trenches there should be narrow raised pathways by which the gardeners may obtain access to the trees. It will be necessary as the trees advance in height to turn the pots occasionally; otherwise the roots are apt to strike through the pots and to penetrate the ground. It is best to prepare the trench of the required length and breadth in the first place, next to arrange the pots in rows therein, and then to fill up the spaces between the rows with earth. Where flower-pots are as cheap as they are in Mozufferpore, *viz.*, from Rs. 3 to Rs. 4 per 100, no hesitation should be felt about breaking each pot at the time of transplanting a young tree.

As regards the distance apart at which trees should be planted on roadside avenues, much depends on the kind of tree and on the locality. As a general rule, I would plant Pipul, Bur, and Rain-trees 50 feet, and all the others in the list from 30 to 40 feet.

If trees are not planted out by the sides of the roads until they are 5 or 6 feet high, and if they are planted out at the commencement of the rainy season, they will not require, in a climate like that of North Behar, to be watered in the following hot season. By that time their roots will have reached such a depth as to be able to dispense with artificial supplies of water, and nothing beyond general supervision and attention to the state of the gabions will be required. This duty can easily be performed by members of Road Committees, and the officers of their engineering departments. In drier parts of the country, it may be necessary to give water during the succeeding cold and hot season. And it may be advisable in very dry localities to adopt the plan of sinking a pot (kulsi) near the root of each plant, and keeping it filled with water at all times of drought during the first year or two after transplantation.

The holes in which the trees are to be planted by the roadside ought to be carefully prepared some months beforehand, and some old manure, where available, should be mixed with the earth. These holes should be at least 2½ feet wide and 2 feet deep, but if money be available, larger holes, say 4 feet in diameter and 3 feet

deep, are preferable. The height of the gabion* is of great importance. The two evils to be guarded against are (1) "the poisonous tooth,' as Virgil calls it, "of the accursed goat" which is certainly more injurious to the young tree than winter cold and summer heat, and (2) the mischievous habit which travellers have of breaking off the young shoots of the mango and some other kinds of trees and using them as tooth brushes. In places where white ants abound, it is a good plan to smear with tar the ends of the posts before fixing them in the ground, and a daub or two across other parts of the posts will deter villagers from extracting and appropriating them for their own use.

I would strongly recommend that avenues be planted with due regard to symmetry and convenience, and that large and small fruit-bearing and timber trees be not planted indiscriminately together. If it is intended eventually to sell the fruit of fruit-bearing trees year by year, it will be most convenient to plant a few miles of each road with each of the most valuable kinds of fruit trees *e. g.*, five miles with *Mangifera indica* five miles with *Artocarpus integrifolia*, five miles with *Bassia latifolia*, &c. This is the principle which I adopted in Mozufferpore town, where I planted about 12 miles of avenues with 12 different kinds of trees, fruit-bearing and timber, allowing one mile or so for each kind of tree.

The trees, which should specially be planted where the soil is suitable for their growth; are the following ;—

Fruit trees.

Botanical name.	Native name.
Mangifera indica.	*Am.*
Eugenia Jambolana.	*Jamun.*
Aegle Marmelos.	*Bel.*
Bassia latifolia.	*Mohwa.*
Artocarpus integrifolia.	*Jak* (or *Kantal.*)

Timber trees.

Botanical name.	*Native name.*
Swietenia ... Mahogani.	*Mahogany.*
Swietenia ... macrophylla.	*Large-leaved Mahogany.*
Gmelina arborea.	*Kumbar* or *Gambar.*
Dalbergia Sissoo.	*Sissu.*
Cedrela Toona.	*Toon.*
Casuarina equisetifolia.	*Jhao.*
Pongamia glabra.	*Karanj.*
Albizzia Lebbek.	*Sirish.*
Pithecolobium Saman.	*Rain-tree.*
Lagerstrœmia Reginæ.	*Jarul.*
Pterospermum acerifolium.	*Kanuk Champa.*
Ficus ... religiosa.	*Pipal.*
Ficus ... bengalensis.	*Bur.*

NOTE.—In the case of the two species of Ficus in the above list (Pipal and Bur) it is best not to plant seedlings, but branches of adult trees. The branches selected should be straight, from four to eight feet long and from three to five inches in diameter.

* If a bamboo gabion is too expensive or inconvenient, a mound of earth topped with aloe leaves, or a ring of bricks placed alternately so as to admit light and air, where bricks are cheap, may be substituted.

When I left Mozufferpore district in December 1882, the total length of avenues on the district roads was about 210 miles, most of which were in very fair condition ; while along some 12 miles of roads in Mozufferpore town there were about 2,800 trees all of valuable kinds, which had been planted and maintained under my own immediate supervision at less than an average cost of Re. 1-8 per tree and most of which no longer required any special protection.—(*Indian Agriculturist.*)

Forests in Russian Turkestan.

According to the February number of the *Geographical Journal*, Russian Turkestan is so poor in forests, and the existing woodlands have suffered so much of late from reckless cutting, that attempts are now being made to replant, partly in the mountains and partly in the Steppes. It is estimated that of the total area of Turkestan (162,000,000 acres), the territory has but 945,000 acres of forest land in the mountains, and nearly 16,000,000 acres of bushland in the Steppes. As to the plantations of trees which are met with in all native towns and villages, they cannot even satisfy the wants of the steadily increasing population for building purposes. The saxaul tree has been pitilessly exterminated all along the banks of the Syr Daria, and for a great distance around the centres of population, and, as natives say, "the saxaul has fled into the depth of the Steppes." The forests in the mountains were also recklessly cut down till the year 1879. At the same time, the whole of the region is, from some physical change, generally undergoing dessication. Both glaciers and rivers are decreasing; the lakes dry up; the extremes of temperature become more marked; and the moving sands are increasing in area. The recent attempts at planting forest trees, without irrigation, which where made in the province of Samarcand in 1880, have proved quite successful; so also the attempts made in the dry Steppe in the south of Samarcand, between the Shaar-sabiz Mountains and the Dargh Canal, where nearly 400 acres were planted. Since 1880 the system has been improved, the young trees being now planted on the slopes of the hills in terraces, which follow the contour lines. (*Pioneer.*)

Fellows of Coopers Hill.

We hear from England that the following old Coopers Hill Forest Students have been appointed 'Fellows of Coopers Hill., C. G. Rogers; B. B. Osmaston; H. H. Haines; F. A. Leete; S. Carr. We offer them our congratulations.

Technical Education for Geologists and Foresters.

It is a noteworthy fact, which may be usefully borne in mind by the promoters of Technical Education, that the Government of India have, in the Resolution published in last Saturday's *Gazette*, declared that the system of appointing Asiatics as probationers in the Geological Department must be abandoned. The reason given is that habits of observation and practical inquiry are not sufficiently developed in natives by the present system of education. We are aware that the late Director of the Geological Department, Mr. Medlicott, took a still more hopeless view, and insisted that original investigation of high class could never be expected from the native of this country at all. The Government of India have never accepted this conclusion. Indeed, in the Resolution just quoted, they imply their belief that the qualities essential to independent and original work in the field of geological investigation can, and will, be produced by an improved system of school education. This view is confirmed by experience in the Forest Department, in which some of the students who have received a practical education in the field and in the museum, and whose powers of observation have been trained and stimulated by the instruction adopted at the Dehra Forest School have shown considerable aptitude for original research. It may be hoped that the reforms now being introduced into the general educational system of India, will remove from it the charge of being unable to turn out students fitted for the important work of scientific research, on which the future development of the wealth of the country so much depends.—(*Pioneer*).

Sapless Cedar Block Paving.

In a paper recently read before the Western Society of Engineers and printed in the Journal of the Association of Engineering Societies, Mr. Thomas Appleton gives a brief account of the manufacture and durability of the sapless cedar block paving, or, in plainer terms, a pavement of cedar blocks from which the sapwood has been removed, now in use in the town of East Saginaw, Mich. Prior to 1886 the cedar paving blocks used were sawn from peeled cedar fence posts, the bark and knots only being removed. On most of the streets of the town the travel was not heavy enough to wear out this pavement before it perished by decay. This decay naturally took place soonest in the sapwood, which, being softer than the heartwood, broomed up and wore away, leaving a rounded top surface to the block, and making a very rough pavement in a few years. It was therefore decided to try a cedar paving block with the sapwood removed. The first of this was laid in 1886, and since that time no other kind has been used. An examination of the sapless block paving laid in 1886, made in October, 1892, showed that the blocks were sound on all sides, and that there had been very little brooming. Details of the manufacture and cost of these sapless cedar blocks are given as follows by Mr. Appleton :—

In manufacturing the sapless blocks, the cedar is first sawed into block lengths. It is not necessary to remove the bark, as it comes off with the sapwood. The blocks are then taken to a press or punching machine. The bed of this machine has holes 4 in., 5 in., 6 in., 7 in., 8in., 9 in., and 10 in. in diameter. At the top of these holes circular collars or knives are secured, standing up 2 in. or 3 in. above the bed plate. A block is placed on one of these knives, and the plate descending forces the block down through the hole in the bed, while the sapwood and bark is shaved off above the bed. The intention is to take off all the sapwood and no more, so that the attendant places the block over the largest die that he thinks the heartwood will fill. In case he misjudges the size of the heartwood, and the resulting block still has some sapwood upon it, the block can be punched again through the next smaller-sized die, and the sapwood entirely removed. Generally, the defective blocks as they come from the punching press are taken to a second machine, which has one straight knife and other knives of various radii of curvature, and these fit in the bed, and remove the sapwood and bark or any decayed wood that may be on one side of the block.

• The block from the punching press has a very pretty appearance. Each block is a perfect cylinder, with sides straight and true. No knots or bunches are left, so that they can be set close together in paving. Those that have passed through the second machine have equally straight sides, but their cross-section

is not always a true circle ; it may be a segment of a circle with a straight side. But there are plenty of places for split blocks, and long as the block are sound and free from sapwood it is not essential that they should all be exactly cylindrical.

The common cedar block is made only from small-sized trees, of such size as would be used for fence posts. The sapless block is made from any size of tree, large or small, solid or hollow-hearted. Any piece that has 4 in. of good heartwood goes into paving blocks, but the wood is all heartwood, and of good sound timber.

The average cedar block has from 25 per cent. to 35 per cent. sapwood upon it. Sap ¾ in. thick on a 7 in. block would make 24 per cent, sapwood. On a 4 in. block the same thickness of sapwood would make 34 per cent. of the entire area of the block. On some blocks the sapwood will run more than ¾ in. in thickness. Throwing away 34 per cent. of the material adds to the cost of the paving. A pertinent inquiry is, what does this sapless cedar block cost? On the first piece of cedar block paving in East Saginaw the extra cost for sapless blocks was 10 cents per square yard over the cost of common blocks. Recent figures for sapless block paving in some of our suburbs give a difference of 30 cents per square yard. It is understood that this latter difference is largely due to the cost of railway freight from the block manufactory in Michigan. If the blocks were manufactured in this city just as the common blocks are, this difference of 30 cents per square yard would probably be reduced.—*Timber Trades Journal.*

The American cedars are species of 'Thuja'

Hon. Ed.

THE

INDIAN FORESTER.

Vol. XIX.] May, 1893. [No 5.

On Forest Administration.

The article "On Forest Settlement and Administration," which appeared in the March number of the *Indian Forester* deprecates the arrangement adopted in Madras of allowing Revenue Officials a large share in the administration of forests.

As a Madras Forest Officer who has been in charge of a district for the past 10 years, I say that I have found but few of the defects pointed out by "Futaie."

Futaie says that "the control of the Reserved, as well as of 'the Protected, is rapidly slipping, or has already slipped, away 'from the Forest to the Revenue Department." Here is the chief point in the whole article, and I propose to discuss it so far as Madras is concerned.

The management of forests in Madras in undertaken by

(1). Government.

(2). Board of Revenue advised by Conservator.

(2). Collector of the District advised by District Forest Officer.

The latter has the chief management and working of the forests, of course, subject to regulations laid down by the two former. It is with the latter I propose first and chiefly to deal.

The Collector in Madras is, of course, *the* chief of the District, not only in the Revenue, but also in the Forest, Magisterial, Police, and almost every other Civil Department.

The question now arises, "Does the Collector stand in the way 'of the District Forest Officer, or does he help him?" I have been District Forest Officer under six Collectors, and can confident-

ly state that the latter is the case, at all events with the present generation of Collectors. The Collector of the present day thoroughly understands that the reservation of forests is beneficial to the people, and that the future agricultural interests are furthered by restrictions at present of so-called privileges, such as promiscuous fellings in the forests, excessive grazing, grassfiring, forest clearings and even the imposition of fees.

The present day Collector is not afraid of dissatisfaction occurring amongst the people in regard to Forest measures, provided those measures are not suddenly and immoderately introduced. Thus, in the course of a few years, thousands of acres may be closed to felling or to grazing without fuss or murmur if done gradually ; but, if done suddenly and all at once, this closure would probably cause grave dissatisfaction, and even riots. In these matters, the Collector is the Conservative, as compared with the Forest Radical : the brake on the coach to prevent its running down hill too fast.

It is absurd to say that the Collector only regards agricultural interests, as he is the head of the Agricultural Department, and does not regard Forest interests except from an agricultural point of view ; just as much as it would be to say that he does not regard magisterial interests, except from an agricultural point of view.

It is equally absurd to say that the Revenue Department has been "bribed to take right action, &c." Collectors are being shown that forest projects are interesting, and are interested accordingly, if matters are properly and thoroughly explained to them. They are being "physically educated up to a rational and 'impartial treatment of forest affairs." The question is rather, whether the average forest officer is "educated up to a rational and 'impartial treatment of agricultural and magisterial affairs." I think not, I think that his zeal over forest matters biasses him on that side ; and that he is not interested in agricultural matters. Perhaps if he were "bribed to take a right action by the concession 'of a larger share in the management" of agricultural and magisterial affairs, he might see that he has been so biassed.

The arrangement of the Forest Officer being an assistant to the Collector has a double effect. *Firstly*, it is my experience that the Collector is almost invariably willing to leave purely technical matters to his forest assistant; he is willing to learn all that he can about forest management, provided that the Forest Officer proceeds with tact and does not setto work either to lay down the law or to use long technical phrases, with which the Collector has no acquaintance ; he is willing to listen to his District Forest Officer's arguments and be guided by his opinion, provided he has no weighty argument in return. *Secondly*, the District Forest Officer hears the Collector's views on the subject, taken if you will, from an Agricultural or Magisterial stand point ; and he consequently sees both sides of the question.

The result is that Collectors take a proper interest in forest matters, and that Forest Officers take a more unbiassed view of their projects, which would not happen if they were independent of each other.

There are other ways in which the coalition strengthens the hands of Forest Officials. *Firstly*, the Department being under-officered, we constantly find young Assistants or Extra-Assistants of one or two years' standing at the head of affairs in a District. Presuming that this young Assistant is zealous in his work, he longs to make innovations and improvements, pooh-poohs custom, considers that the thief of a head load of firewood is a greater villain than a house breaker, or swindler, &c. &c. : who could better restrain him from making himself and the department a laughing stock than a kindly Collector, who knows enough about young men to do it without hurting his Assistant's feelings ?

Again, without the Collector's authority, Tahsildars have a nasty way of acquiescing in proposals to get a thing done, but six months or so afterwards furnishing a most plausible reason why it should not be done. The time lost is generally, by Europeans, considered valuable.

Again, the Collector being head of the Local Fund Board can often have roads and buildings, most useful to the department, constructed from Local Funds.

Again, the Collector, when visiting localities where Subordinate Magistrates, reside, can, as District Magistrate, explain to such Subordinate Magistrates that forest offences should not be treated as trivial one or two anna offences.

Thus, a great deal can be gained for the Department by the Forest Officer being Assistant to, and technical adviser of the Collector.

It is true that lately the Board of Revenue have taken upon themselves the control of finances which formerly vested in the Conservator. The reason for that was patent and need not be referred to here. But the Conservator being adviser to the Board should, I think, with tact and rationality, even now, have as much control over those finances, as it was ever intended by the Code for him to have.

Finally, the concluding part of 'Futaie's' article seems to some extent to approve of the coalition arrangement existing in Madras ; for he wishes a Forest Official to be Joint Secretary to Government. The Collector has the District Forest Officer, the Board of Revenue has the Conservator, and why should not the Local Government have an Inspector-General, to advise ?

COUPE DE REGENERATION.

Deodar in Kulu.

The most important tree of the Himalaya, the Deodar, is not unfrequently found mixed with the two Pines, the two Firs and the three Oaks, the Moru, (*Q. dilatata*) the Ban, (*Q. incana*) and the Karshu, (*Q. semecarpifolia.*)

In Bashahr, the tree extends to the vicinity of the arid zone where it is often found associated with the edible pine (*Pinus Gerardiana*) which latter is the most characteristic tree of the dry climate.

Pure Deodar forests are not rare in Kulu. Such forests are found either on abandoned fields (often in the vicinity of Deotas' temples); on land where, I believe, shifting cultivation had previously been practised; or in steep and generally inaccessible localities where they have not been subjected to ill usage at the hand of man. All these classes of pure forests are generally regular.

That loose soil is always the best suited for Deodar is quite apparent from the fact that Deodar encroaches upon adjoining fields with such a marked rapidity, that in a single year acres will be covered with an almost continuous mat of seedlings ; the result being that if such fields are not taken care of for a few successive years, they will have ultimately to be given up by the holders.

As a matter of fact, Deodar seed would always germinate very readily where the soil is sufficiently loose and moist, but the young seedlings growing in the open, where they do not find sufficient shade, dry up again in the succeeding hot months. Those exposed to the south are less likely to survive than those growing on other aspects. It is mostly on account of the absence of such shelter that Deodar sowings in patches in the unshaded areas, have, except in a few rare cases, where a couple of succeeding seasons have been exceptionally favourable, almost always resulted in failure.

In such open and unsheltered localities I would recommend that the *Blue pine* should always be raised, before Deodar sowings or plantings are taken in land. The Blue Pine would cover such grounds very quickly, and would, of course, nurse and force up the Deodar when the latter is introduced there. The desired result may be thus very soon obtained.

In many a grassy land throughout the valley, wherever firing had been put a stop to, if the situation were in any way favorable and the seed trees were not far distant, the young growth of *Kail* subsequent to the occurrence of the latest fires reminds one of the *Rakhs* of the lower hills where the forest fires always result in a beautiful crop of young seedlings of *Dodonœa viscosa*. It may be advisable, therefore, to set fire to all such open lands before Kail seed is sown there. But patches to receive seed should always be kept prepared beforehand. Deodar seed is heavy, some 225 grains per ounce. It often falls close to the seed bearers. As most of the pure Deodar forests in Kulu lie amongst cultivation, whenever a

sufficient number of seed bearers fringe the outskirts of such forests, it requires no labor or time to find the adjacent fields full of seedlings.

Unless such parent trees are removed by some untrained hand, the seedlings would do well under them and very few of them are likely to fall victims to the heat and dryness of the following seasons. Thus, if left alone, Deodar would go on extending itself till it had occupied the whole of the cultivation.

The occurrence of pure forests standing on deserted lands may be attributed to the Deodar thus spreading from the sacred groves surrounding the Deotas' temples or from a group of trees in fields.

The Deotas in Kulu, whose presence in the low lying Deodar forests probably accounts for the existence of the latter, have been, from time immemorial, much dreaded by the people.

The plants coming up from the seed shed by the trees of the sacred groves, were sometimes held to be the property of the temples, and owing to fear of and respect for the Deotas, the cultivators made no attempts to destroy them.

All forests which thus sprang up, have been of late years in possession of the Forest Department.

In fact, the people in Kulu always looked upon the Deodar as a temple tree and without the previous permission of the Deotas it could not be obtained.

For every tree they thus removed, they had always to pay either in cash, in goats, or in grain. Since the management of the Kulu forests has been in the hands of Government, it has been ruled that Deodar may not be claimed even on payment.

It is also probable that the district was once more thickly populated than it now is. All the old fields now occupied by Deodar were once cultivated, but the successive invasions of the Goorkhas, the Mandi people and the Sikhs, resulted in their being deserted, the consequence being, that wherever seed bearers were at hand, the whole of the deserted fields were taken up by Deodar.

It is on this account that most of the present low-lying Deod forests of Kulu are often of uniform size and age.

The present year (1893) has been exceptionally favorable the natural growth of Deodar in Kulu. The winter of 1891 w an abnormally dry one, it was therefore followed by a good se year.

There was hardly a single Deodar tree in the valley which di not bear cones in 1892. A large quantity of Deodar seed w shed in November-December, 1892, and thanks to the sprin rains, every seed seems to have germinated.

Thus, the natural reproduction, so far, is very satisfacto the next season may be perhaps comparatively dry. Cor more than 95 per cent. of the present seedlings may f

On the other hand, if the succeeding years pr able for these young plants to establish ther

shall have, without any labor, some of the bare grassy lands covered with Deodar plants of equal age.

A few regular and pure deodar forests, found in localities where probably the people used to burn down the jungle in patches to take off it a few crops occasionally, have had their origin, I believe, in this manner, But quite different is the history of pure Deodar forests found on steep slopes or at high elevations.

As a representative of this class of forests, may be mentioned the Rolla and Drad forests of Sahraj, where hundreds of Deodar trees grow pure on rocky ledges in a comparatively poor soil. All such forests were, in the beginning, I believe, either mixed or pure forests of Pine and Spruce. Deodar which somehow or other got introduced there, drove out all these species, thus forming pure forests of its own. A good example of this may now be seen *in the mixed forests of Mahli Dhar and Bung in Sahraj, where* Deodar has already begun to establish itself and is expelling all other species. In the course of the next few years, Deodar is sure to dominate and ultimately to suppress all its companions—the Chil (*P. longifolia*) the Kail (*P. excelsa*) and the Rai (*A. Smithiana*)—and the forest will become one of pure Deodar.

But the most dangerous companion of Deodar is the Silver fir. If all other circumstances are favorable, the Silver fir would naturally keep the Deodar back altogether. With the exception of this enemy, I would never recommend that any of the usual companions should be ringed or otherwise removed. I would always leave the trees to fight their own battle.

Young seedlings of Deodar are, of course, readily browsed by goats, but when once it starts fairly, it cannot be easily suppressed. About the sapling stage, however, the condition it loves best is a side shade through the influence of which the Deodar would clear itself rapidly of its lower branches and attain tall boles.

Pines, Oaks and Rhododendron when mixed with Deodar, are the greatest safeguards against fires, as they keep down the undergrowth of grass and of more worthless species and also greatly increase the production of the soil.

As a rule, and naturally so, the reproduction of Deodar in Kulu in the mixed forests of Deodar and Pines is usually plentiful, while that of the latter is invariably conspicuous by its absence, because no seedling of pine or even of spruce would ever stand shade.

Both Oaks and Pines and sometimesSpruce are therefore the most useful companions of the cedar, inasmuch as they always foster it when it is young and simply disappear when they are no longer required.

Once the Deodar forms a thicket and throws out its powerful ...would grow in any soil under even the most unfavorable

... poor soils the trees would not, however, attain ... as is the case in Dungruthana Shila, Paneo, ... many other forests and sometimes if they

do attain the usual dimensions, they would begin to decay at the centre at a comparatively very early age, as is the case in Dalogi forest, where although the trees are very tall and clean boled, they have already begun to rot at the centre and probably in a few years hence none of them will be found healthy and sound.

It may also be due, to some extent, to the evil consequences of *the removal of dead leaves and consequently to the absence of* nitrogenous substances that the trees in the Dalogi forest have thus begun to decay ; but if the soil were deep enough, they would not, I believe, have suffered so much through the absence of humus.

On the other hand, the Deodar, when it once sets out fairly in deep clayey or loamy soils, would always stand even the most serious injuries.

As an instance of this type of forests, may be mentioned the Kalandi Dhar forest of outer Sahraj, which, when the Mandi people conquered that part of Kulu and set fire to all hamlets on that side was, probably, composed of straight Deodar poles.

The moment the invaders left the country, the people began rebuilding their houses. For this purpose every available pole in the above forest was cut away. The stools left behind were not, however, without side branches. As soon as the leader was off, the remaining branches turned up to form a number of leaders, the result being that the present growth at first sight resembles a coppice.

Similarly, wherever in rich soils the leader of an old tree gets injured, the tree does not die out, but the nearest side branch turns up to form what is termed a secondary or a false leader. Such trees are found in almost every old Deodar forest in Kulu.

As the care and proper supervision of Deodar will have the special attention of the Forest Department, no Deodar forest should ever be *clean cut*. I would recommend that all Deodar forests should be treated by selection felling, while we must be very careful to cut as few trees as possible on the steep slopes.

I doubt very much the advisability of Deodar sowing *in situ*. It is, I believe, more satisfactory to raise the plants in a nursery.

The principle, therefore, which we must never lose sight of is to have seedlings ready at hand to put out just after the felling operations are over and to give the forest perfect rest.

Sometimes, when a virgin forest is felled over, where the undergrowth is very scanty, and where the soil is full of humus, sowing broadcast or in patches may succeed.

The bad effects of the policy of falling back on artificial reproduction for filling up the areas denuded of Deodar by heavy felling, after having given in vain, for years, sufficien[illegible] and air to allow a young growth to spring up, are quite [illegible] in the Nachar forest in Bashahr, in Daogi and Jibi in S[illegible] Bindraban and Phulga in Waziri Rupi, in Sandhar and [illegible] in Upper Kulu and a *good many other forests*.

In all these areas heavily worked over, all conditions combined together have been very favorable to the luxuriant growth of *Desmodium*, *Indigofera*, *Berberis*, Brambles, *Viburnum* and numerous other weeds. Such worthless species are now found occupying every foot of the ground and if a Deodar seedling comes up anywhere, they would overshadow it and would thus retard its growth.

We cannot possibly get rid of such inferior species by cutting off or ringbarking. The best means to clear them away, in order to re-stock the areas with Deodar, would be, I believe, in raising a tree which would readily come up under such circumstances. Deodar should always be introduced later on. Regenerating all such ruined forests otherwise would be a matter of time and heavy expense.

At present, it is most difficult to find in any of the above forests, any traces of natural reproduction at all, while the artificial sowings and plantings, have not produced the desired result, except where such operations were taken in hand just in time, as was the case in some patches in Nachar in Bashahr, where Col. Bachelor had sown some Deodar seed broadcast, just when felling operations were going on and the worthless species had not yet time to spring up ; and in the upper portion of Latura Forest in Kulu.

The natural reproduction of Deodar in forests lightly worked out is generally good.

As an instance of this, may be mentioned the Blajdhar Forest of Sahraj. In is in such forests that the tree may be encouraged by artificial means.

Our aim must be always to re-stock and improve the forests, and therefore all badly growing and topsore trees should be removed at once.

Subsequent to fellings and the removal of suppressed trees, all blanks must be filled up as soon as possible and invariably before the inferior species have had time to come up.

As a rule, no forest should ever be worked unless we have got in nurseries at hand, a sufficient number of Deodar plants ready to be used at once wherever necessary.

Almost all the workable Deodar forests in Kulu have been of late years somewhat heavily felled over. The Kulu forests are still unclassed forests, the late lax rules of the Department have also much added to their present state of depletion.

The trees which escaped the Departmental axe were not rarely removed and utilized by the Zamindars, the consequence being t the present forests have been to such an extent exploited, that will hardly be able, for a good number of years to come, ly for felling more than fifty Deodar trees a year.

young Deodar forests of Kulu are, however, well stocked, lantations in the Upper Valley, where thousands of ave been raised artificially, are, of course, of very d show the masterly hand of the Forest Officers.

In about forty years time the Kulu Division will yield annually the largest number of Deodar trees in the Punjab.

Nearly all *these natural young Deodar forests have come up* in spite of grazing. I am strongly of opinion, therefore, that moderate grazing by cows and bullocks does not do any damage to the young reproduction of Deodar. The cows would hardly touch the plant, even if there is nothing else for them to eat.

The present young Deodar forests standing on lands close to villages in Kulu, and of necessity grazed over by cattle almost every day during the whole time the plants were young and the grass had not yet died out, lead me to the belief that cow grazing does not much interfere with the young growth of Deodar. As a matter of fact, I would not allow grazing of cows on slopes, but when the most ruined forests on almost flat and abandoned cultivations have to be re-stocked, where the needles if not triturated *under the feet of cows form a thick covering of undecayed* vegetable matter and the soil becomes matted with weeds and inferior species, almost the only means to encourage natural reproduction is, I believe, by allowing moderate grazing. My belief is greatly intensified by observation. I find that all such areas heavily felled over and subsequently kept fenced and closed have thus got full of needles, weeds and worthless species, and it is sometimes quite in vain to search for a single natural seedling.

Great care should always be taken in gathering seed. If raw and unhealthy seed is sown we can never expect success. The cotyledons of healthy seed are generally green and if they are not so, the seed must be considered in an unhealthy state. As a rule, the seed should always be collected from isolated trees. The *seed of such trees is generally good and when sown hardly ever* fails.

The age at which Deodar trees in Kulu attain workable girth, varies with soil, aspect, altitude and other circumstances.

It is probable that the following figures give a fairly accurate average.

GIRTHS.

4′ 6″ to 5 ft.	6′ to 6′ 6″	to 7′ 6″	to 8′ 6″	to 9′ 6″	to 10′6″	to 11′6″	12′
AGE.							
50 years.	88	100	115	132	152	180	195-200

From 30 to 35 years are probably sufficient for trees of 4½ feet in girth to attain a girth of 6 feet. This cannot, however, be said to be the case in general.

In some compact pure forests where the Deodar grows close together, the trees may grow to a considerable height but they would hardly ever attain large girths. As an instance of this type

of forests, may be mentioned the Dalogi Forest of Sahraj, where, although the trees are very tall and the whole crop not less than 300 years old, the average girth is hardly above 6½ feet.

MIAN MOTI SINGH.

Kulu, 8th April, 1893.

The Commutation of privileges in Bahraich.

The following notes on a scheme for commuting the wood privileges of villagers resident within 3 miles of the State Forests of the Motipur Range, Bahraich Division, Oudh Circle, may interest the readers of the "*Forester.*"

Area affected.

The Local Government, in its Notification No. 441, dated 7th May, 1879, granted villagers resident within 3 miles of the boundary of the State Forests, the privilege of taking poles of the inferior kinds of trees for their own *boná fide* domestic and farming purposes free of charge, and of grazing their cattle in the State forests at reduced rates, but reserved to itself the right of discontinuing these concessions whenever it pleased. These privileges can only be exercised in the "Open Forests," the area of which in the Motipur Range is about 68,556 acres out of a total area of 1,18,776 acres. The greater portion of the "Open Forests" (*viz*, over 60,000 acres) is situated on the low alluvial plains of the Rivers Ghogra and Kauriâla and consists chiefly of grass lands interspersed with khair and shisham trees. This area is used chiefly as a grazing ground and is not capable of supplying timber such as is required by the villagers, and consequently this demand has to be met from the remainder of the "Open Forests," with an area of about 8,000 acres. This tract comprises the three open compartments which form part of the main sal Forests, *viz* :—the Bahay Forest, the open compartment between Motipur and Kakraha, and the open compartments between Dharmanpur and Jallia gourhi ; the two latter compartments contain a considerable quantity of sal, and all three are protected from fire but open to grazing.

Present method of exploitation.

Under the present system, the privileged villagers are entitled to as much timber, &c., as they require for their domestic and farming purposes, and the only restriction imposed by Government rules as regards locality, manner of cutting, &c., is that the produce

must be taken from the open Forests. There is no attempt at any systematic plan of working, nor can the Forest officials enforce the simplest sylvicultural rules, or take any precaution against wanton and destructive methods of exploitation; for, so long as they obtain a permit, the concessionists have a perfectly free hand in the open Forests ; blanks are increased ; trees are ruthlessly cut away without regard to the state of the soil, reproduction, &c.; and the over-head cover is opened out to such a degree as to expose the soil to climatic influences, while all protection in the shape of grass and undergrowth is destroyed by cattle.

Injury done by the concessionists.

The damage thus done to the present crop is enormous, while the deterioration of the soil is so great that forests which have been thus maltreated for any length of time, are incapable of producing good growth in the future. A striking example of the irreparable damage done by allowing ignorant villagers to have unrestricted liberty of cutting trees in valuable Forests, is shown in the case of the Bhinga Reserve in the Bahraich Division. The soil of this once magnificent sal producing area has been impoverished to such an extent by over cutting and excessive grazing, that it is impossible for it to produce another crop of sal unless artificial means are resorted to ; and when the present stock of sal either dies from natural causes or is removed, this forest will be reduced to the status of a scrub jungle covered chiefly with thorn bushes, and be incapable of even supplying the demands of the privileged villagers.

Amount of timber and poles removed annually.

To give an idea of the drain on the forests open to concessionists, it may be mentioned that there are 110 "privileged villages" adjoining the Motipur Range, the residents of which extracted 92,676 poles and 15,791 other pieces of timber from the open forests of this Range during the year 1891-92, while (as has been explained above) the greater number of the 108,467 trees were removed from an area of about 8,000 acres. It might be thought that each supply of building materials would last at least 3 or 4 years, but this is far from being the case, as indents for the full amount of their requirements are received annually from the householders ; and when questioned on this point, they state that the wood which they now obtain, being immature and of inferior quality, decays every year. The forests are thus burdened annually with the full requirements of 110 villages. Under these adverse conditions of excessive felling and grazing, the denudation of these forests is merely a matter of time and it is with a view to check this destruction, to reduce the total exploitation by 4-5ths and if possible to re-establish the fertility of the soil, that the present proposals are suggested.

Proposed future working.

To better understand these proposals, it is necessary to describe briefly the future system of working in this Range, so far as it concerns this scheme. A Working Plan is being prepared for these forests in which work will be prescibed for the three Working Circles described below :—

I. *Nishangara Working Circle*, which will include all the closed Forests from the Orai Nulla and the Nepaulese pillar No. 79 on the North, to the Jallia-Salarpurwa line on the South.

II. *Murtiha Working Circle*, consisting of the closed Forests between the Jallia Salarpurwa and the Bulcha-Bhamania lines.

III. *Motipur Working Circle*, containing the closed Forests from the Bulcha-Bhamania line to the Ghagowa Nullah.

The period for which work is being prescribed in these Circles in the present Working Plan is 15 years, and during this period improvement fellings will be undertaken annually in certain fixed portions of each Circle. The out-turn from these fellings will, in the first instance, be sold to lessees, but there will be large quantities of poles and suppressed trees available for supplying the requirements of the privileged villagers, and it is proposed to utilize this surplus stock for commuting the concessions under consideration. The timber thus set aside for the use of the privileged villagers, would consist chiefly of the better kinds of wood and be more durable than the wood of the inferior species now taken by them, and each householder's supply should last at least from 5 to 10 years. The coupes in each Working Circle will be marked a year before the felling is undertaken, and separate hammers would be used for marking trees for lessees and for privileged villagers.

Proposed rules regulating the supply of timber to concessionists.

The following rules show the manner in which the concessions may be commuted without inflicting hardship on the tenantry, while the exploitations would be carried on systematically, and with due regard to the potential capability of the Forests.

I. Sal timber and poles will be supplied free to each householder once in 5 years from the coupes in which cuttings are prescribed in the Working Plan. In cases of arson, however, timber will be supplied again free of charge, although the full term of 5 years may not have expired since the last supply.

II. All the privileged villages adjoining the Forests of the Motipur Range will be divided into 3 groups (or "chucks") to correspond with the 3 Working Circles and each group of villages will draw its requirements from a particular Working Circle. It is proposed that this grouping of the villages should, in the first instance, be made by the landlords, who are best qualified to

ascertain the convenience of the tenantry, and then be submitted to the Divisional Officer who would satisfy himself that each Working Circle is capable of supplying the requirements of the group of villages attached to it. If the Divisional Officer is of opinion that the probable out-turn from any Working Circle will be insufficient to meet the demand on it, he will make such modifications in the grouping of the villages as the circumstances of each case necessitate, and communicate the alterations thus made to the landlords concerned.

III. When the village-groups have been finally settled, the Forest Officer will prepare a nominal list of all the householders, and a statement showing the quantity of building material, etc., required by each.

IV. One-fifth of the total requirements of each group of villages will be supplied annually from the Working Circle to which it is attached, the rotation in which individuals or villages are to be supplied being decided by the landlords.

V. On the 1st October of each year, the landlords will submit to the Forest Officer an indent for the quantity of sal timber required by the villagers of each group, such amount not to exceed one-fifth of the total as ascertained under Rule III.

VI. It will be seen that under these arrangements it will take 5 years to supply the full requirements of all the villages in each group; consequently, during the first four years, a certain proportion of timber required by the remaining villages must consist of miscellaneous species. So that for the first four years it will be necessary to send the Forest Officer 2 sets of indents, one for sal (as mentioned in Rule V) and the other for miscellaneous timber.

VII. By the 1st December of each year, the timber required by the indents mentioned in V and VI will be marked by the Forest Department, and the villagers will be at liberty to enter the forests and cut trees thus set apart for their use.

VIII. After the timber has been cut, it will be inspected by some specially authorized forest official who will enter in a register the amount of produce taken out by each villager and issue a pass for its removal.

IX. All the cutting and export must be completed by the 31st March of each year, after which date no one would be allowed to enter the Forests.

X. The privileged villagers would not be allowed to obtain timber or poles from any of the forests in which grazing or firin[illegible] is permitted, and could only cut and remove timber from [illegible] closed forests in accordance with these rules.

XI. Thatching grass might be cut in closed forests [illegible] the 1st October, and 28th February, on permits w[illegible] be supplied free by Rangers and Foresters.

A New Fodder for Cattle.

An article has recently been published in '*Le Temps*' by M. Grandeau, Professor of Agriculture at Nancy, on a new fodder for cattle. This fodder consists of the young branches of trees, more particularly of the Beech and Birch, previously submitted to a special treatment, which is described below.

As is well known, the constituents of a plant, whether it be an annual or a perennial, are generally speaking the same ; cellulose, nitrogenous matter, sugars, fats. The proportion of these substances varies largely from one plant or from one organ of a plant to another; the age of the plant or of its different parts is the chief condition which regulates these differences. In general, the younger an organ, the richer it is in digestible nutritive substances. The reserves of nutritive material formed in special parts of a plant at certain times of the year, are destined to support the life and development of a new plant or a new organ until it is itself able to derive its own nourishment from the soil and the atmosphere. In the autumn, there is a considerable accumulation of such materials in the young branchlets; from which supplies, the young shoots of the spring derive the food substances necessary for their growth. The inner wood of the tree, on the other hand, contains practically none of these nutritive substances: nitrogenous matter, sugar, fat or starch. It is composed almost exclusively of hardened cellulose, more or less incrusted with mineral matter, and practically without any nutritive value.

Frequent trials have long ago been made to substitute partially for hay and straw in the feeding of cattle, sawdust, either crude or previously treated with various chemical agents. These trials have shown that sawdust is harmless as a food and does not cause disorders in the animals fed on it, but at the same time, that it is absolutely inferior as a food to the poorest straw. The first point is important, in so much as the perfect innocuousness of introducing the elements of woody tissue into the digestive organs of horses and cattle is established. As regards the second point, chemical analysis shows that wood richest in nutritive matter is not, weight for weight, equivalent to more than a quarter or a third of the nutritive value of the poorest straw. In speaking of the instinctive dislike cattle have of this kind of fodder, M. Grandeau mentions the well-known criticism of this method of feeding by a Norwegian Agriculturalist, who said that a peasant who had been ommended this regime for his bullocks, has only been able to nade them to eat the sawdust by providing them with green les in order to make them think they were eating good ass.

nappropriate wood may be as a fodder, it is quite nall branches, gathered in autumn, chopped up

and submitted to a special process of fermentation such as that devised by M. Ramann. M. Grandeau gives a table showing as an example of the rule mentioned above, how the quantities of the different nutritive substances contained in the small branches (of a diameter not more than one centimetre) of the Beech vary according to the season. This table shows that such branchlets contain a very much larger percentage of albumen, fats and starch in the winter than they do at the time of the opening of the buds or during the growing period; and also that the general nutritive qualities of these are equivalant to those of hay of medium quality and greatly superior to those of the best straw.

To transform such branchlets into fodder M. Ramann has prescribed the following treatment. First, they are broken up mechanically by a crusher specially adapted for the purpose and which is not expensive, next they are submitted to a regular fermentation effected as follows. To the broken branches is added 1 per cent of malt, they are then watered with warm water and left to ferment. After a time, which may vary from one to three days, the temperature of the mass rises to 60 ° or 70 °C., it should be maintained at a temperature of between 50 ° and 60 ° by stirring the mass, adding from time to time more liquid. The action of the malt transforms the starch into sugar, the other changes brought about by the fermentation are somewhat complex, but the final result is the production of a substance which is eagerly eaten by horses and cattle and very well digested by them. Experiments conducted on a large scale with this fodder on horses, cattle and sheep, of which several instances are quoted by M. Grandeau, have given excellent results, conclusively proving the superiority of the new fodder over straw.

The economy realized by this new method of feeding is also considerable; the gathering of small branches is not costly and takes away nothing from the value of the produce felled in a forest. The cost of preparation is estimated by M. Jena at from 1 f. 10 to 1 f. 75 per 100 kilgrams.

Branchlets of fruit trees and small shurbs can, M. Grandeau thinks, be used with equal advantage in feeding cattle, and interesting experiments might be made with these at times when other fodder is scarce. M. Grandeau concludes his article with the remark that the Forest Department will doubtless see no greater harm in allowing the gathering of small twigs and branches from its forests, than in the removal of dead leaves for the benefit of small cultivators, permitted, in cases of necessity, in the forest regions of France. *(From Révue des Eaux et Forêts).*

A. F. G.

A Second Note on the Potato Disease in the Poona District and elsewhere.

The experiments of 1892-93 are described in detailed in Mr. Mollison's note, which is appended. The methods and results of cultivation are there fully described, and in this memorandum only the general inferences to be deduced need be dealt with.

Last year's note elicited a good deal of enquiry, and among other facts of interest it was ascertained that the "bangadi" or ring disease was much more widely spread than was at first known. It has established itself throughout the Bombay Presidency including Gujarát, and has been found in the Nilgiris, at Bangalore, and in Bengal. There can be no doubt that preventive measures should be adopted without delay wherever the disease has made its appearance, and fortunately the results of the present experiments are encouraging as regards the practical steps to be taken.

Among other communications received from correspondents some useful information was obtained from Mr. DeJoss, Superintendent at Panchgani, through the Collector o Sátára. Mr. DeJoss found that burning the soil with vegetable material, the land having been previously well turned up with the plough and exposed to the sun, was effective to destroy desease-germs, and he succeeded in producing a crop of several varieties which was remarkably free from disease. Three of these were, however, plainly grown from newly imported stocks, and they were planted on the ridge system and not in beds as by native cultivators. Major Radcliffe, Assistant Commissary-General at Mhow, wrote recommending the pulling of the haulms and also suggested that the "Magnum Bonum" variety might prove strong enough to resist the disease. We have, however, as shown in Mr. Mollison's note, found other varieties superior to the Magnum Bonum, and the idea of pulling the haulms was based on the assumption that the fungus, as in the European disease, fructifies on the foliage of the plant, which is not the case. But Major Radcliffe's recommendation gains interest from the latest conclusions reached by Dr. Cunningham, which also point to the pulling of the haulms as a preventive measure, though on somewhat different grounds. Mr. Creighton Duff of Coonoor is pursuing a series of experiments with potash and other manures intended to fortify the plant-system against infection.

Dr. Cunningham's researches were this season obstructed in some degree by an unexpected difficulty, viz., by the failure of the diseased seed supplied to him for cultivation to reproduce the disease in the crop grown at Calcutta. Probably, the diseased potatoes decomposed so far in transport as to lose their power of germination, and only the comparatively healthy ones survived. In any case, it must on no account be taken as proved that diseased sets produced a sound crop because they were grown on virgin soil. No conclusion has been more clearly pointed to by the experiments and observations conducted in the field during the past two years, than that the disease is propagated from the seed as well as from the soil, and that if anything the first source of infection is the more dangerous and common.

On the other hand, Dr. Cunningham is inclined to a contrary opinion, microscopical investigation leading him to believe that the lesions in the tuber are of a secondary nature. The primary lesions, he writes, are those in the haulms, and it is the disturbance of nutritive conditions determined by these which occasions the pathological changes in the tuber. He says, "I should certainly be inclined to believe that the disease is maintained not by the use of diseased tubers as such, but as the result of planting either diseased or healthy ones in soil contaminated by containing portions of the haulms with their mycelial and specially their sclerotioid contents." It may be added in this connection that the brownish tinge in the haulm which was noticed last year as a chief diagnostic symptom, has this year been much less marked. But although the discolouration has been less striking, following on an absence of the previously observed tendency to the formation of sclerotioid masses within the larger vessels, it is always discoverable on section, Dr. Cunningham observing that in such preparations "the presence of abundant although generally isolated mycelial filaments comes out very clearly especially within the spiral vessels." In some young plants examined he found abundant mycelium in the cortical and pith tissues, whereas last year the fungal masses were noticed in the vascular system only. Pulling *and burning* the haulms might, apparently, tend to save the soil from infection, but it is doubtful whether this can be recommended in practice. The disease develops itself most a little below the soil surface, and extends downwards as well as upwards in the stem. When pulled, the stem breaks off at the main point of disease-developments, and as many germs would be left in the soil as would be removed.

The practical result of the Khed experiments of the past season is to show that certain varieties of imported seed can and do resist infection in a marked degree. The provisional inferences of last year were against this conclusion, but Mr. Mollison's experimental results have fully established it, and the cultivators of the district are eager to obtain seed from the new stocks at almost any price. Unfortunately, it is difficult to keep the cold weather seed

till the following winter, because of its tendency to sprout in the monsoon months, and it becomes necessary to grow a crop during the rains to provide seed for the main crop cultivation of the next cold weather. This rain-crop is not always as sound in cultivation as the dry-season produce, and here we find another cause tending to the deterioration of all stocks after they have been grown in this country for any length of time.

The "Bouillie Bordelaise" treatment of the land *before sowing* has succeeded in a very considerable degree, and there can be no doubt that flushing diseased land with the copper sulphate solution in the manner adopted in these experiments is specific as regards all disease germs which it reaches. It has been found in a large degree to protect sound plants from infection and to prevent the spread of disease from one plant to another. The treatment with caustic lime and soot has been inconclusive because the imported seed proved so robust that the failure of the disease to make headway cannot with certainty be attributed to the treatment adopted.

The same somewhat unexpected degree of success with the imported seed has prevented any very clear differentiation being arrived at with respect to the methods of cultivation followed. The ridge and furrow system, however, has not been proved to have the full advantage at first expected. This is probably due to the more rapid growth and maturing of the tubers in this country, the crop being ready in 14-15 weeks as against at least 20 weeks in Europe. The bed system with its superabundance of surface moisture, seems to enable the plant to effect the more rapid assimilation of food necessary under Indian conditions. But, on the other hand, it is extremely probable, as pointed out by Mr. Mollison, that the constitution of the plant is unfavourably affected by this luxuriance of growth and is more prone to disease in consequence.

The lesson so far learnt is that the disease may be largely checked by the use of the copper salt, but that reliance must chiefly be placed on the distribution of robust seed of the varieties which have been found most successful. It has also been found that the small cut sets used by natives induce weak growth, and that large cut sets or, better still, medium sized potatoes planted whole produce more vigorous seedlings. Great interest has been taken by native cultivators in the experiments, and they have shown themselves ready to take large quantities of seed at prices much over the market rates for the indigenous kind. There is therefore every prospect, at least in the Poona district, of our being now able to effect in the course of a few years a thorough change in the stocks cultivated, but it must be added that there is little prospect of inducing the rayats to give their land the needed rest from potato, without which all measures can only be palliative and no permanent cure can be expected

E. L. CAPPEL.

Notes on Forest Entomology.

We have received Nos. 1 and 2 of Vol. III of the useful 'Museum Notes' which are edited by Mr. E. C. Cotes. Although many of our readers will doubtless read these notes in original, we think it may be as well to extract a few of those which are most interesting from a forest point of view.

(1). In South India, Sandal is such a valuable tree that any disease in it requires to be most carefully investigated with a view to remedy. The following extract will be of interest to Forest Officers in Sandal Districts.

"A good deal of damage is said to have been done in 1891 to 'young sandal wood (*Santalum album*) trees in Mysore by a 'boring insect. According to a report, dated 13th July 1891, by 'the Assistant Conservator of Forests, Mysore, furnished through 'the Director of the Dehra Dun Forest School, this borer attacks 'both the stem and the roots, either killing the sapling outright or 'weakening it, so that it is liable to get blown over by the wind. 'Sandal wood yields an important revenue to the Mysore State, so 'that any damage done to the young trees is of consequence.

'The insect that seems to be chiefly responsible for the 'damage is the caterpillar of the moth *Zeuzera coffeæ*, Nietner, a 'species which occasionally attacks both coffee (*Coffea arabica*) 'and tea (*Camellia theifera*) bushes."

(2). The Dun is almost celebrated for its Mango gardens, but sometimes these gardens suffer from curious attacks now of insects, again of fungi, which are obviously detrimental to the

maintenance of the fruit supply. This was the case in 1891, many mango gardens having suffered from a small fly which damaged the young leaf shoots as described in the following extract.

"In April 1891 the Director of the Forest School, Dehra 'Dun, forwarded blighted shoots of mango (*Mangifera indica*), 'with the information that the whole of the mango trees in a large 'garden near Dehra were attacked, though, strangely enough, other 'trees close by had not suffered. The blighted shoots were aborted, 'so as to appear almost like a series of little green rosebuds upon 'the twigs. These false buds were found to contain mature '*Psyllidæ* (*i.e.*, minute fly-like Rhynchota allied to the Aphidæ). 'The insect has not previously been described from India, so it 'was sent to Mr. G. B. Buckton, in England, for determination. 'He has named it *Psylla cistellata*."

(3). Tamarind beetle: we extract. "From the Secretary to 'the Agri-Horticultural Society of India were received (6th July '1891) specimens in different stages of development of a Bruchid 'which attacks the seed of the Tamarind tree (*Tamarindus indica*) 'in Calcutta. The insect was submitted to Mons. A. Fauvel, who 'has kindly examined it and reports that it belongs to the species '*Caryoborus* (*Bruchus*) *gonagra*."

(4). During the tours of the Forest School students, many interesting notes are often made on the entomology of the forests, and more especially since the entomology prizes have become a feature of the School Examinations. The following extract refers to the small beetles which burrow between the bark and wood of the blue pine trees which had been barked or girdled in order to relieve suppressed deodar beneath them.

"In May 1891 the Conservator of the Forest School Circle 'forwarded, from his camp near Chakrata in the North-West 'Himalayas, a log of *Pinus excelsa* attacked by a bark-boring 'Scolytid. This insect was said to have attacked some trees that 'had been girdled, and were dying. The specimens were submitted 'to Mr. W. F. H. Blandford who very kindly examined them and 'determined them as belonging to a species of *Polygraphus* near 'to the European form *Polygraphus pubescens* Linn. For an ac'count of *P. pubescens* which Mr. Blandford thinks likely to 'prove similar in habits to the *Pinus excelsa* insect, see Eichhoff. 'Eur. Borkenkäfer, page 122, (1881)."

(5). Similar investigations have been made in other Circles, witness the following.

"In July 1891 a number of insects were received through the 'Director of the Dehra Dun Forest School, from the Officiating 'Conservator of Forests, Central Circle, North-Western Provinces 'and Oudh, with information that they had proved destructive to 'Chir (*Pinus longifolia*, in the Baldhoti plantations.

'The specimens were found to comprise four species of 'Acrididæ (*viz.*, *Chrotogonus sp.*, *Catantops indicus*, *Caloptenus sp.*, 'and *Œdulus sp.*, all said to nip off the young plants, also

'numerous obscure Curculionidæ beetles and earwigs (Euplexop-'tera) said to be found in dying trees, and probably therefore of 'but little importance. The Acridid responsible for most of the 'nipping off of the young *chir* trees is probably the *Chrotogonus*, 'of which numerous specimens were furnished. This insect is a 'very common one in many parts of India, and has repeatedly 'been sent to the Indian Museum as destructive to crops, but no 'satisfactory method seems to have yet been discovered for dealing 'with it. The bran and arsenic insecticide, which is said to have 'been successfully used in the United States against some kinds of 'Acrididæ, might perhaps be worth trying. It is made by mixing 'together one part of arsenic, one part of sugar, and six parts of 'bran, with a little water to form a paste. It should be sprinkled 'over the plantation for the Acrididæ to eat; the greatest care, how-'ever, is necessary in using it on account of the poisonous nature 'of the arsenic."

(6). The large beetles of the family of the erambycidæ are among the most destructive of the borers which attack the Sal (*Shorea robusta*). The following extract refers to similar attacks on an Assam species of Shorea and will be found of interest.

"In August 1891 a block of *Makai* wood (*Shorea assamica*) 'was received through the Dehra Dun Forest School, from the De-'puty Conservator of Forests, Lakhimpur Division, Assam. It was 'found to be tunnelled in all directions by Cerambycidæ larvæ. A 'full grown beetle emerged shortly after the block was received 'and proved to be closely allied to a specimen in the Museum 'collection determined by Dr. Lameere as *Neocerambyx holosericeus* '(=*Æolesthes holosericeus, Gahan*). It differs, however, from this 'species, in possessing a series of spines on the antennæ. A 'specimen of the Cucujid *Hectarthrun brevifossum* Newm. also 'emerged in the rearing cage from the same block, and may, 'perhaps, prove to be parasitic on the Cerambycid.

(7). Black unwholesome looking sticky messes are often seen on forest and fruit trees, and most often on the orange and lime. The following extract refers to an unpleasant attack of the sort which affected the thorny bamboos at Dehra.

"In March 1892 specimens were forwarded by the Director 'of the Forest School, Dehra, of an Aphid which was found attack-'ing the leaves of *Bambusa arundinacea* in the school compound. 'The insect covered the leaves with a black sticky gum which was 'in such quantities that it fell off in drops. The insect is unnamed 'in the Museum collection, and specimens have therefore been 'forwarded to Europe for comparative examination." It has since 'been named '*Oregma bambusæ*' by Mr. Buckton.

(8). "Insects said to infest the *Terminalia belerica* tree in 'the Thana district, Bombay, were forwarded to the Museum in 'February 1891 by Mr. F. Gleadow of the Forest Department. 'The insects were found to be of two kinds—(1) a Bostrychid 'borer, identical with specimens reported on by Dr. Gunther of the

'British Museum as *Sinoxylon sp.*, and (2) a small Cucujid which 'has been submitted to Mons. Fairmiare, who has kindly examin-'ed it and reports that it belongs to the species *Læmotmetus* '*insignis*, Grouville. The Cucujid is not likely to do much damage, 'but the Bostrychid is very probably destructive."

(9). The beetle, the subject of the next extract, was discovered by the noise he made in carrying on his excavations in the specimens in the Forest School Museum. He might have had a grand feast and tasted the qualities of many kinds of woods had he not made such a noise over his work.

"Specimens of the Cerambycid beetle, *Stromatium barbatum*, 'Fabr., were forwarded to the Museum in June 1891 by the 'Director of the Forest School, Dehra, with the information that 'they had been damaging wood specimens in the School Museum. 'A block of khair wood (*Acacia Catechu*) that was forwarded with 'the beetles was found to have the whole of the sap wood riddled 'with tunnels made by the larvæ. These tunnels were tightly 'packed with the powdered wood that had been eaten out and pro-'bably passed through the digestive organs of the grub. The 'hard heart wood was untouched."

(10). "In March 1891, specimens of an insect, said to injure '*gall-nut* trees (*? Terminalia Chebula*) on the Kambakkan 'hills, were sent to the Indian Museum, through the Dehra Forest 'School, by the District Forest Officer, Chingleput, Madras. The 'specimens proved to be little cone-shaped larval cases of a Psychid 'moth. They were a little larger in size but otherwise indistin-'guishable from the larval cases of the species *Babula grotei*, Moore, 'a species which often defoliates ornamental shrubs in Calcutta 'gardens."

(11). Finally, we will conclude with the following remarkable note on the red mites which may, we hope, elicit information to confirm Mr. Clifford's observations on the subject.

"A note written some years ago by Mr. M. H. Clifford, late 'of the Forest Department, has recently been found amongst some 'old papers in Dehra. According to this note, native hakims ex-'tract a kind of oil from the large velvety red mites (*Tetranychus* '*sp.*), commonly known as *red spiders or Birbhoti* in the North-'West Provinces. The oil is sold for medicinal purposes at a high 'price, and even the insects themselves fetch as much as a rupee 'per tola. It will be interesting to learn if anything further is 'known of the medicinal virtues attributed to this mite."

There can be no doubt that the information afforded by these very simple observations will be of great value to the Department, and we think that every advantage should be taken of Mr. Cotes' being at the Calcutta Museum to get forest insect phenomena investigated and information recorded as to the identity of the animals and the best means of encouraging them or repressing them, as the case may be.

(To be continued).

"A trip to Bara Bangahal."

(Concluded.)

6th June.—Started early before sunrise to visit the gorges and cliffs west of the valley I went over yesterday.—The scenery is very wild and impressive. The cliffs and peaks are so pointed and steep, they look as if they would come tumbling down any moment. We spotted 3 Ibex high up one of the gorges, but the ground was too dangerous to permit of our stalking them. After breakfast, returned down the valley with the camp to Dalli Gote, where I had bagged the monster bear on the 4th June. Our road lay along the Ravi, which was covered over with snow 15 to 20 feet deep in places ; the walking was easy, though dangerous, as even such thickness of snow will occasionally crack up and let one down into a rushing torrent below. Saw nothing else all day but an adder which we destroyed.

7th June.—Started at dawn for the Larum nala a perfect paradise for brown bear. The nala or both sides is covered with beautiful Blue Pine forests and occasional strips of Deodar with open glades where bears feed. We passed a shepherd *en route* who was bemoaning the loss of three of his sheep killed during the night by a leopard, I wished I had had time to stop another day to look up Mr. "Spots," but I was anxious to finish the inspection of this last nala, and get back to head quarters. Soon after getting well up the nala, we spotted a young brown bear which was undoubtedly the one I had had 9 shots at on the 5th June, for he was very uneasy, and would not stop to feed. While tracking him, I spotted a splendid old brown bear across the valley—so left the cub to settle down, while we hurried on to get up to the big one. After some difficult walking and scrambling over fallen trees and soft snow, we came right on to him, feeding in an open glade and bagged him after hitting him twice. It being now too late to skin him, we rolled him under a rock, covered him over with stones and leaves, and tied my handkerchief as a flag over his carcase to frighten away hungry foxes, and then hurried back to camp, which we did not reach till dark. Killed two more adders to-day.

8th June.—Was too fatigued last night to sleep well, so did not start on my rambles till late in the day. Just as I was sitting down to enjoy breakfast in the forest, I spotted a she bear, and two large cubs across the ravine. Leaving the breakfast to take care of itself, the Shikary and I started off sharp to get above them, I soon got within shooting distance, and bagged the she bear and one of the cubs, the other escaped before I could reload. A single barrel rifle is decidedly a mistake. Later in the evening I came across the cub again and bagged him and soon after, on our way back to camp got within easy shot of another very handsome bear which I was fortunate to bag too, making in all 4 bears to-day. The dark colored bears with silver tipped fur are far handsomer than the ordinary light redish colored ones.

9th June.—*Was enjoying a Sunday morning in bed* when I was awakened by the excited shikary who ran in to say he had spotted a bear opposite our camp—and that he was quite close. I certainly felt very disinclined to get up, for I had had enough bear shooting; however, it was time to get up, so I dressed leisurely and walked out to see it, which was across the stream running past our tents. The sweeper just then let go the dogs, who catching sight of Mr. Bruin hurried on to make his acquaintance and we much enjoyed watching the chase which was more exciting than shooting bears. Returned to Bara Bangahal village in the afternoon.

10th June.—Started early and pitched camp in the Dhanna Gote, first stage to the Thanesar Pass. Shot several snow pigeons *en route* ; a dreary evening, raining hard ; completed a map of the Bara Bangahal Valley, and was amusing myself cleaning up my guns and rifle to put away, as there was no hope of any more shikar once we had crossed the Pass, when there was suddenly a shout of "bear" from two or three of the coolies in camp. Running out with my rifle and getting over the broken ice covering the stream below us, I got a shot at what turned out to be a sheep-*eating bear ; he was a splendid specimen, but had a* very mangy head, I had 5 shots at him before I could kill him.

11th June.—Up at dawn and after an awful climb of 5 hours through snow, and over rocks, we reached the top of the Thawsar Pass 16,729 ft. above sea level, at 11 o'clock. The view was most magnificient, nothing but snow all round us as far as the eye could see. The glare of the sun on the snow was awful, and I was glad to start on the downward journey after finishing my breakfast ; the whole day's journey, which lasted till 5 p. m., was through snow ; tobogging was freely indulged in by coolies and all and was certainly the easiest way of getting over the ground. Three of the unfortunate coolies suffered from the cold and the glare, and were almost blinded. Pitched camp at Jhoodi. This must be the end of "The trip to Bara Bangahal" for we had no more sport after leaving Jhoodi.

F. O. L.

Sir Edwin Arnold, the Monkeys and the Cocoanuts.

Can cocoanuts be plucked from trees as one would pluck cherries or hazel nuts? Sir Edwin Arnold appears to think they can: in fact he says he has seen monkeys plucking them. His description of this interesting and unique occurrence may be found in one of those delightful articles which are now appearing from his pen in the *Daily Telegraph*, and of which the following is an extract. In writing about books of travel and how much they interested and impressed him when he was a boy; he says:—"Day after day I 'revelled in that rich feast of ocean adventure, and day after day 'wished more and more for myself also to sail the sea and to cast 'eyes upon those fair and various lands, those strange peoples, 'those lovely islands set like jewels in the silver of the main, and 'shining under such glad and warm skies. Especially do I 'remember one prodiguous volume which described some old 'worthy's travels in India and which contained a plate that charged 'my imagination brim-full of wonder and interest. It represented 'a scene upon the Malabar coast, with the sea gently breaking 'along a sandy bay, the curve of which was fringed with cocoanut 'tropical vegetation. Monkeys were climbing the stems of the 'palms or perched in their frondage; and curiously shaped and 'coloured birds hovered over the edge of the waters or waded in the 'lagoons. It saturated me, that ancient picture, with the passion 'and the purpose to see India, some day and to study the trees and 'flowers and birds and beasts and inhabitants of such a surprising 'country. All which has since duly befallen, for books are mighty 'in guiding and controlling us. I recall one hot, silent memorable 'day in the Concan in India, when we came down from the hills 'where we had been shooting, to take passage in a pattimar for 'Bombay. We sat under the shade of the cocoa-palms by the edge 'of the rippling Indian Ocean. Where had I seen the beautiful, 'wild, quiet scene before? When had I before visited that sleeping 'sunny bay of the Malabar shore with its long curving lines of 'cocoanut trees fringing the blue water, its milky wavelets break-'ing upon the golden sand, washing the shells and star fish and 'clumps of bronze sea weed and red rocks? What made the spot 'upon which I was certainly now for the first time planting my 'delighted feet, so impossibly familiar, so unreasonably known? 'I seemed to recognise every feature in the landscape and the sea-'scape, the very boats fishing were such as I had viewed in the 'very same places, and the cut of the mat-sails on the trading bunks 'and the dress of the sailors and fishermen bore no new appearance. 'Puzzled and meditative, I was wondering if the Hindoo doctrine 'of former existences was indeed true, when my Mahratta shikari

'called out, "Bandur lôk! dekho sahib," "Look at the monkeys." 'Behind us, in a near clump of cocoa-palms, some of the four-handed folk were demurely ascending a tree full of nuts, and two of them 'were already ensconced in the crown *plucking of the green fruit.* 'In a moment I remembered. It was the veritable scene depicted in 'that old book of travels! By accident—if anything in human life 'can be so called—my boy's dream and desire had come precisely 'true. There was the place before my eyes over which I had hung 'entranced in the nursery, it was the actual spot realised; if King 'George's artisis had limned it by my side, he could not have hit off 'that lovely nook of Malabar with happier precision.'

G. E. M.

Corean Paper-Making.

A report of the United States Consul-General in Corea, treats of the manufacture of paper. This is one of the leading industries, for paper is highly esteemed, and always forms part of Royal presents, and of the tribute paid to China. Besides its use for writing and books, it is employed in a great diversity of ways. It serves as string, and in the manufacture of lanterns, fans, umbrellas, shoe soles, hats, boxes, and coats. It is also used for covering floors, walls, and ceilings, and, stretched on frames, supplies windows and doors. Corean paper is highly prized in China and Japan, and is especially sought for the manufacture of umbrellas. It is made, from a bush of the mulberry order (*Broussonetia papyrifera*), which is indigenous, growing in many parts of the kingdom, but thriving best in the moist, warm climate of the south. It is chiefly grown from cuttings for this especial purpose, and the wild and cultivated plants are said to be of equal value. The bark, which alone is used, is generally gathered in the spring, and it is boiled for a long time in water, in which a quantity of wood ashes has been mixed, until it becomes a pulp, the mass having been beaten during the whole time of the boiling. Fine bamboo screens are then placed in shallow wooden vats, and a ladleful of the pulp is evenly spread over the screen by a dexterous circular motion of the hand. This operation is repeated once or twice, or as often as may be necessary—the more frequent the operation the finer the paper—and the screen is allowed to drain into the vats until a proper consistency is reached, the drippings being thus saved. They are placed on a hot floor to dry. After the drying has proceeded far enough, the paper is again laid on a hot floor and ironed by hand. The long lines in the paper show strands of the bamboo screens, and their nearness, distinctness or absence indicate the fineness or otherwise of the paper. They are almost imperceptible in some grades of paper, while in others they are distinct and far apart. Paper is made by the Paper Guild, a numerous and prosperous association. The province of Chulla is the chief seat of manufacture. (*Times*).

THE

INDIAN FORESTER.

Vol. XIX.] **June, 1893.** **[No 6.**

Tea-Box Woods.

In a note on INDIAN WOODS FOR TEA BOXES, by Mr. Edgar Thurston, Officiating Reporter to the Government of India on Economic Products, which was published as an Appendix to the *Indian Forester* for November 1892, I find it stated that Messrs. Davenport & Co., of Calcutta, annually import from Japan some 1,500,000 boxes of red Pine (*P. Thunbergii*) of uniform tare, *viz.*, 19 lbs., and with the dimensions 23″ × 19″ × 18″ with 2″ dovetail. There is therefore, it is said, a very great opening in Eastern India for the manufacture of tea-boxes from some good light wood, which, however, must be sold in Calcutta for not more than 14 annas each, and yet leave a margin of profit for both the producer and the middleman. The main points to be kept in view are, it is said, that the boxes must not be heavier or more expensive that the Japanese boxes, and that the wood must be sweet smelling, and free from all kind of taint, by which, I suppose, is meant that the wood must not have properties which will corrode the sheet lead with which the boxes are lined, and so allow the tea to get spoiled. Before, therefore, people can be induced to take up the trade, the right kind of wood must be found in sufficient quantity and in suitable situations. Sample tea-boxes made from Japan Wood were sent to the Chief Forest Officers of Assam, the Andamans, and the Pegu Circle, Burma, and they were asked to ascertain whether woods suitable for the purpose were obtainable in the forests under their charge ; and Mr. Thurston gives a *précis* of their reports, and adds information on the subject already published in the *Indian Forester*. The Conservator of Forests in Assam had reported in 1883 that he had arrived at the conclusion that there was no wood in Assam which, if properly seasoned, would damage the lead in which tea is packed : if not seasoned, the extent to which different woods would damage tea-lead must vary greatly, almost any wood would spoil tea-lead if used without being seasoned. The Conservator now said that there was an abundance

of light tough wood, easily worked, and therefore suitable for tea-boxes in Assam, to meet an increasing demand, and he stated the localities whence a supply could best be drawn. The number of boxes made from Government timber at Tezpur and Lakhimpur had increased from 118,657 in 1888-89 to 394,127 in 1891-92, and the royalty paid to Government from Rs. 7,218 to Rs. 17,792. The rate of royalty is stated to be one anna a box : but at that rate the royalty for 1891-92 would be Rs. 24,633. It seems possible that the number of boxes is overstated by one lakh. Tea-boxes are, in Assam, generally made from *Semal* (*Bombax malabaricum*) and three or four other light and inferior woods, but Mr. McKee, the Officiating Conservator, says that only *Semal* is produced in sufficient abundance.—He thinks it is likely that the local saw-mills of Lakhimpur Darrang, and Cachar will before long supply the greater part of the box demand. All the gardens in those districts are now supplied by local mills, which obtain their timber either from the Forest Department or from private grants, and Mr. McKee says there are reasons for believing that the number of mills will be increased before long, as it is found that boxes can be supplied by them at nearly half the rate charged by the Calcutta houses, and of sufficiently good material.

The Deputy Conservator of Forests in the Andaman Islands reported that he had cut up a quantity of *Didu (Bombax insigne,* and therefore, it is presumed, a wood similar to *Semal)* for tea-boxes, and that these were valued in Calcutta, before being tenoned and morticed, at 14 annas a box. Mr. Carter, Conservator of Forests of the Pegu Circle in Burma, reported that there were two common trees which, when converted into tea-boxes, might possibly compete with Japanese wood in the Calcutta market and one of these was that of the *Bombax insigne,* mentioned by the Andaman Officer. Mr. Dansey, Conservator of Forests, Bengal, stated that, having regard to the nature of the country, the difficulty of obtaining labour for the ordinary requirements of the tea concerns, and the very few local species of any use for the purpose, he did not think it strange that Bengal should not be able to compete with Japan in the tea-box industry. The Kurseong Divisional Officer said that Tea Managers thereabouts, preferred Japan boxes, which when made up cost Re. 1-4 each, to those made from local wood which cost 1-1-4 to Re. 1-2-6. One of these local woods is stated by Mr. Gamble, in Vol. IX, 1883, of the *Indian Forester* to be *Semal* ; and in a letter to Mr. Thurston, Mr. Gamble said that *Semal* and other soft woods could be got in abundance and cheaply in the Chittagong forests and he suggested that the timber could be floated down to Chittagong and be there cut up by a tidal water-wheel mill and sent cheaply to Calcutta.

Finally, it appears from a list of tea-box woods used by the planters of the Kangra District, that *Semal* (spelled *Simul* all through Mr. Thurston's paper) is one of them ; and in a note to this

entry the reporter says that Mr. Gamble informs him that in the Dehra Dún, the planters all use Mango wood ; because all their tea goes to the Commissariat Department and the Military Department, which gets the tea for the troops, insist on Mango wood because the wood of the empty tea-boxes can be utilized.

The prominent facts noted in Mr. Thurston's paper are, (1) that boards, or shooks, of pine wood are imported in large quantities from Japan to be made up into boxes to hold Indian Tea, and that these, after coming thousands of miles by sea are sent hundreds of miles up country by rail, and though slightly dearer, are preferred to locally made boxes.

(2). That *Semal* and a few other Indian woods are light and good enough for tea-boxes.

(3). That *Semal* or the allied species, *Bombax insigne*, is used so far as available, along with other woods, for tea-boxes, in India, from the Andamans to the Kangra Valley, except in Dehra Dún.

(4). That the Japanese tea-boxes are made of Pine wood and that two species of Pine and two of Fir are used for the same purpose, and though these are strong smelling and more or less resinous woods, they appear not to be objected to by purchasers of Indian Tea.

(5). The reason why *Semal* is not used for tea-boxes in the Dehra Dún is said to be that nearly all the tea there produced goes to the Commissariat Department, and it is required to be packed in Mango wood boxes because these can be utilised when emptied.

(6). The boxes made from local woods, including *Semal*, in the Districts of Lakhimpur, Darrang and Cachar are said to cost not much more than half the price of boxes made from the Japan shooks.

As I have a considerable stake in one of the Dehra Dún Tea Companies, and as I know that a considerable proportion of the Tea of that Company is sent for sale to London and to Canada, where there can be no special demand for Mango wood, and as I have for years seen the groves of magnificent old Mango trees in the Dún being felled to meet the demand for tea boxes, I have been naturally led to think that the denudation might be somewhat lessened and perhaps the cost of boxes cheapened, if the tea for London and Canada were to be packed in boxes made of *Semal* wood, which grows, self sown, all over the Dún; and I have intended to suggest this to the Board of Directors of my Company. But, I now see that Mr. Thurston's paper suggests many other questions, which I think may be profitably discussed in the pages of the *Indian Forester*, and I will now proceed to name some of them.

The *first* question that occurs to me is that it is strange that the Forest Department in India cannot produce enough of timber

suitable for tea-boxes, and at a rate cheap enough. Is it not a pity that the tea industry of India should be so greatly dependent on Japan for boxes? From a letter addressed by Mr. J. S. Gamble, to the *Indian Forester*, published in the number for October 1883, it appears that *teak* wood was then the ruling material for tea-boxes in Bengal, and Mr. Gamble said :—" It is important that the "utilization of indigenous woods should be encouraged, for it seems "absurd that the vast forests of Assam and Cachar should be said to "be unable to produce tea-box woods sufficiently cheaply to compete "with teak wood from Burma." This leads me to inquire whether *Semal* trees are conserved in Eastern India, or cut out, to make room for more valuable timber. Further, if they are conserved, is any aid given to natural production by sowing, or propagation by cutting, which latter mode, I am told, is easy?

But, *Second*, is not the disgrace of having to import tea-boxes from Japan largely shared by the tea planters? And is not the loss, by increased cost of boxes, largely owing to their own negligence. Most tea estates have a considerable extent of land under forest, and *Semal*, is, I believe, universally distributed. Do the planters encourage its growth, and propagate it? If not, considering that the process is so easy, and the tree has so quick a growth, why not?

Third. This leads me to inquire whether Mango wood boxes are insisted upon by the Commissariat and Military Departments down country, as they are in the North-Western Provinces and Punjab.

Fourth. Supposing the case of a tea garden with no forest land: might not *Semal* be grown all over the garden, without injury but perhaps even with benefit, to the tea crop, as Sissu is grown in some gardens in the Dún. It is a tree with few branches, and does not give a dense shade. Would its roots interfere with those of the tea bushes, or would the shedding of the cotton-covered seeds on the bushes affect to any serious extent the plucking and manufacture of the tea-leaf. I think, as a rule, the seeding of the *Semal* must be over before there is much flush on the tea.

Fifth. In how many years does a *Semal* tree become large enough to yield planks fit for tea-boxes; and what is the weight of a tea-box of seasoned *Semal* wood, 23″ × 19″ × 18″? And how many boxes would a young tree, just fit to be felled, yield, at a cubic foot of timber per maund of tea, the rate given by the Assam Conservator of Forests? What is the weight of a Mango wood box of the above named size?

Sixth. I presume that the slabs and branches of *Semal* would be of use as fuel.

Another series of questions occurs to me with reference to Mango wood, though in putting them, I, perhaps, only show ignorance. *First*, all large Mango trees that I have seen, yield

only small inferior *desi* fruit and the size to which Bombay and other grafted mango trees grow seems limited. Is the latter fact because gardens of grafted mangos are all yet young and will they in time grow up into big timber trees, and be fit for tea-boxes ?

Second. What is to happen to the tea industry in the Dún, and other districts, under the influence of the arbitrary Military Department when the old Mango trees have all been used up.

Third. Are *desi*, or timber-producing mango trees being systematically planted by land owners to take the place of the mature trees when felled and if so, has that been done ever since Mango wood boxes were insisted on ; and when will *desi* trees so planted become fit for felling ?

Fourth. Is the age of a large Mango timber tree known ? If not, might not the Imperial Forest School authorities count the rings on a series of stumps.

Fifth. Ought not the Directors of Tea Companies, and owners of private gardens, to insist, in preference to Mango wood, in the interests of the Mango tree, as well as for economy's sake that *Semal* wood be used for all boxes in which tea is packed for export and local sale, and not for the Commissariat ?

Sixth. If by the systematic growth of *Semal* wood and its use for tea-boxes, planters in the Dún and elsewhere could tender to supply the Commissariat at a cheaper rate than at present (one pice per pound might be of importance) might not the Commissariat and Military Departments abandon their insistance on the use of Mango wood ?

Seventh. Seeing that one sort of pine, *Pinus Thunbergii*, is so extensively converted into tea-boxes, and that two other species, and two species of firs are to some extent used in the Kangra Valley, the tea of which has a good reputation, and also that boxes of these woods would work up usefully after they had been emptied of the tea, could not the Military and Commissariat Departments be induced to allow the tea they take to be packed in boxes made of pine or fir wood ?

Eighth. Has any attempt been made by the Forest Department to introduce into India *Pinus Thunbergii*, which seems to be so eminently suitable for tea-boxes ? If such attempt has been made, what has been the success, and when will the trees be fit for felling.

Ninth. Lastly, I am under the impression that there has been some attempt to make tea-boxes of *papier-mâché* or of cellulose ; and as this material could be made of the refuse wood of the forests in India, its production ought to be cheap. Mr. Fisher formerly of the Forest School Circle and now on the Coopers' Hill (Forest Branch) Staff, some years ago told me that he thought it would pay to establish the manufacture of stock for paper-making in the Dún, and I imagine the same stock, with perhaps some cementing

material added, would do for tea-boxes. Can any of the readers of the *Indian Forester* say anything about this?

C. W. HOPE.

Dehra Dun, 10th January, 1893.

Since the above was written, I have seen a Dún planter who tells me that the Commissariat do not insist on Mango wood, and proscribe only *Semal*. Mango wood is used because it is the cheapest to be had.

C. W. H.

TEA-BOX WOODS

(*Note by Hon. Editor.*)

After reading Mr. Hope's article, we thought it best to try and obtain some more information on the subject of woods for tea-boxes in the Dún. It seems that planters are not unwilling to try *Semal* wood boxes, provided they are of the exact dimensions which the Commissariat Department insist on, *viz*, 26 in. × 15 in. × 13 in. the wood being ½ in. thick. Such boxes, of mango wood, cost Rs. 0-13-3 each, with 6 pies extra for French wire nails. Mr. Hearle, the Dún Divisional Officer, estimates the probable requirements of the District at 12,000 of the above sized Commissariat boxes, 4,000 of 23 in. × 20 in. × 20 in. for Orange Pekoe and 3,200 of 21 in. × 20 in. × 20 in. for Pekoe : the two latter costing respectively, without nails, Rs. 1-5-6 and Rs. 1-3-6 each.

Mr. Hearle says that the shoe has certainly not yet begun to pinch and *Semal* wood to be brought into use, for at an auction sale held lately at Hardwar, 28 *Semal* logs, containing 298 cubic feet, were sold for Rs. 34-8 or nearly 2 as. per foot, to be taken to Meerut for indigo boxes such as are sold for 8 annas each.

Not very long ago a quantity of spruce fir wood (*Abies Smithiana*) was cut in the Datmir Forest on the Tons and taken down to the Depôt at Dakhpathar and there cut up, pieces being distributed *free* to planters for trial. No one would, however, have anything to say to it, and the wood had to be sold off for other purposes. Spruce wood can probably be delivered on the Jumna bank in the Dún at 4 to 6 as. per cubic foot and in our opinion it is probably much the best material that planters are likely to find.

We have been favoured by Mr. A. Smythies with the following further note on the subject of the endeavours of the Forest Department to assist planters in finding a good tea-box wood, from which it will be seen that he is of the some opinion that we are, as regards the suitability of spruce fir.

"In October, 1885, some planks of various trees were supplied 'by the Forest Department to one of the largest tea gardens in 'the Dún ; they had been carefully seasoned and with few excep- 'tions they appeared suitable for box purposes. But enquiries 'shewed that in most cases the timber could not be supplied of

'suitable size, and conveniently situated for sowing up. Some of 'the wood was also too heavy. The kinds experimented on were 'Pádal (*Stereospermum suaveolens*), Kumhar (*Gmelina arborea*), 'Bahera (*Terminalia belerica*), Lessora (*Cordia Myxa*), Jhingan '(*Odina Wodier*), Semal (*Bombax malabaricum*), Pula (*Kydia 'calycina*), Aonla (*Phyllanthus Emblica*), and Kharpat (*Garuga 'pinnata*). The latter was thought well of.

'Two years ago the price paid for a Mango-wood box 27 in. '× 16 in. × 14 in. was 12 As. 6 P. and the number of trees 'estimated as the annual consumption in the Dún was 250 to 300, 'with a five years' supply in hand. Since then, however, the 'price has risen; and it is not likely that the Dún can yield 'another three years' supply at the present rates. The total require-'ments of the Dún Gardens in planks 6 in. × 11 in. × ½ in. were 'estimated at that time to be two thousand five hundred scores. 'It behoves the planters, then, to experiment on a large scale with 'some other wood than Mango, and the probability is that the 'spruce fir, well seasoned, would answer their purposes; there is 'any amount of it to be had in the forests beyond Chakrata, and 'it could be floated down the Tons and Jumna, and delievered at 'Dakhpathar. The day is not far distant when they will be com-'pelled to use some other wood than Mango, and if *Semal* is 'objected to by the Commissariat Department, there is no reason 'to make us think that Spruce fir would share the same fate. At 'all events we recommend them to make the experiment while there 'is yet time."

What is really wanted is for the planters to take the matter up themselves. The Forest Department is, we are sure, in spite of Mr. Hope's remarks, anxious to assist them, but after all, its chief business is production, and planters who desire an improved supply of wood, must meet it half way and at any rate say definitely what it is they want to be supplied with, whether in Assam or in the Dún.

HON. ED.

Experiments on the durability of various woods, made at Dehra Dun.

In order to obtain some data on the durability of Indian woods, the Government of India in a Circular No. 45F. of October 31st 1879. para 6, ordered these experiments to be started. Specimens of various species, chiefly those common in the Dún and adjoining hills, were prepared, the size and shape of a metre-gauge Sleeper being chosen as most suitable. These were placed in the ground at the Imperial Forest School, one half of each piece being left exposed, the other half under ground : and in all 39 species were thus treated, most of them being put down in 1881

and a few subsequently at different times. The soil in which the sleepers were buried was a rich sandy clay, giving, on a rough qualitative analysis made by Instructor Mr. A. F. Gradon :—

Sand	35	per cent.
Clay	24	„
Organic matter	5	„

One by one, the weaker and softer kinds disappeared, under the effects of rot and the attacks of white ants : and in August 1892, just eleven years after the commencement of the experiment, the surviving pieces were dug up by the Deputy Director, Mr. Smythies, in the presence of his class of Forest Utilization, with the following results.

Three species had their wood still perfectly sound in every respect, both above and below ground. These were (1) the Himalayan Cypress, (*Cupressus torulosa*) 10 years buried; (2) Teak, 9 years buried; and (3) Anjan (*Hardwickia binata)* 7 years buried. Both Deodar and Sissu after 11 years burial had their heartwood quite sound, but the sapwood has been entirely eaten away by white-ants. Next to these came the two species of Eugenia, Piaman (*Eugenia operculata*) and Jaman (*Eugenia Jambolana)* which lasted well for 9 years but are now beginning to show signs of decay. Sandan (*Ougeinia dalbergioides*) was much the same, as were also Toon (*Cedrela Toona*) and *Albizzia procera*. The Toon was almost untouched above ground, but the buried parts were unmistakeably traversed by the mycelia of fungi. Sain (*Terminalia tomentosa*) and *Albizzia Lebbek* lasted 8 years; *Phyllanthus Emblica*, *Adina cordifolia*, *Cedrela serrata*, *Pinus excelsa* and *Abies Smithiana* remained good for 7 years and then succumbed. *Pinus longifolia* and the three oaks (*Quercus Semecarpifolia*, *incana* and *dilatata*) lasted 6 years. *Aegle Marmelos*, *Stephegyne parvifolia*, *Abies Webbiana* and *Schleichera trijuga* remained good for 5 years. A *Grewia* lasted for four years, while *Lagerströmia parviflora*, *Anogeissus latifolia*, *Acacia arabica*, *Butea frondosa*, *Aesculus indica* and the Mango gave way in 3 years time. It is as well to place on record that Dehra Dún is the broad valley at the base of the Himalaya and between it and the Siwaliks, extending from the Jumna to the Ganges. The altitude of the locality is just about 2,100 feet, the climate is moderately cool and the average annual rainfall 73 inches.

The most remarkable thing about these experiments is the durability of the Cypress, a fact which ought to be remembered in planting trees in the hills, for few trees are so easily grown, even down to the plains in the Dún and further still to Saharanpur. The wood is not unlike deodar , but with a quite different strong scent. The tree thrives best on limestone, but is not really very particular and it grows straight and well in close plantations.

J. S. G.

The Other Side of the Question.

It is an evening in the month of May, a hot May and a hot evening. I am perched some fifteen feet from the ground in a "Machan" where I have been sitting motionless for nearly two hours. My whole body is cramped and uncomfortable, the flies which worried me nearly to distraction before sunset, are now quiescent, but their place is taken by thousands of mosquitoes which alight on every available square inch of skin and, when there is no longer standing room, buzz round my head in hungry swarms. The outlook is picturesque. To my right, a forest lake covered in its shallower portions with the huge lotus blossom in full bloom, freckled with islets of flowering narkal grass, bordered by green rushes and reeds, interspersed with patches of open water in which snake birds and moorhens are disporting themselves. On the dead cotton tree by the side of the lake, a couple of ospreys are perched and occasionally utter their discordant cry. Herons arise with outstretched neck and composing themselves for flight, curve back their heads with harsh croaks. As a background, the sál forest, gorgeous in the new foliage of spring and resplendent with white heavy flower. To my left, a patch of tree jungle, an indescribable mixture of foliage, here and there a thick undergrowth of Jáman, an occasional stretch of greensward which would be no disgrace to a country house in England, a siris tree covering the ground with its scented pods, a rohini with the departing glory of its crimson berries. And within fifteen yards of my perch, a dead buffalo, his hindquarters gone, a busy swarm of insects around him and two circumspect vultures in the tree above. The sun has set, all the beauty has gone from the scene, leaving only the disagreeables. The herd of spotted deer which have afforded pleasant remark for the last half hour have vanished, the stillness of the summer night is interrupted only by the distant call of a Sambhar, which is taken promptly as an excuse for crowing by all the neighbouring peacocks; the busy night-jar is noiselessly flitting around and settling, utters his curious note so like a tapping on a plank ; the crested fish-owl is heard scolding and hooting on the shadowy trees by the waters' edge. And suddenly, attention is directed to a heavy footstep

through the fallen leaves advancing unhesitatingly and without concealment. It ceases as suddenly as it commenced and every faculty is strained to distinguish in the fast falling gloom, the cause of the footsteps and to interpret the reason of the sudden silence. This silence, however, did not last for long. It was succeeded by a rush and a stifled roar and then, horrible to relate, a voice broke the stillness of the night. It was gruff and angry and uttered these words. What the———are you doing? Leave a fellow alone, can't you? And another voice, powerful but gentle, answered, "My son, I save you from destruction, listen to words of wisdom and then proceed on your way." I turned quietly in the "Machan." Two tigers were dimly visible in the gloom of the starry night. The elder and larger, an immense brute who shewed signs of age, was restraining a younger but full grown animal. I repressed my desire to fire and listened to the conversation which ensued. "Yes, replied the youth, this is all very well but when there is a buffalo in the question, and *my* buffalo too, I would rather have my dinner first and then, safe from interference of yours, listen to the words of wisdom you promise! My son, enjoined the elder, if buffalo was my object, I might have secured it long before you arrived on the scene. I lay and watched it at a distance, I heard your approach, saw the dexterous way in which you dispatched it, and after you had taken your fill, might have made a meal myself were I not at that moment the living sepulchre of a Sambhar stag and therefore uninfluenced by the coarse and skinny prey you had made. I appeal to you, whether or not I might on your arrival here this evening, have despatched you with a single blow had I wished to play back on you in any way? The younger grunted deeply and after a pause ungraciously replied that he was is no hurry for his feed as he had only 12 hours before engulfed half the kill which was the subject of his jealousy. "In that case, replied the senior, listen to the story of my life and then fall to with what appetite you may. I may, he began, claim to be a naturalised British subject, for though my parents were Nipalese, I was never under the munificent government which offers a reward of Rs. 10 for my head. Fortunately, the value of the rupee is now infinitesimal and still decreasing, so that this premium is, like most other matters concerning this coin, merely swagger which does not affect me. My parents left the country of their birth on account of the unsportsmanlike behaviour of its inhabitants. You would hardly believe unless I told you—— and here he growled the pronoun—that these wretches have a custom of tracking tigers and surrounding them with one to two hundred elephants. Gradually constricting the circle, they detach shooters, from whom there is absolutely no chance of escape, except to such tigers as are capable of reasoning and keeping their tempers. My parents awoke one morning to find themselves in the toils, but my noble, if somewhat unsympathetic father, made no further remark except to order my mother, under pain of his displeasure, to do exactly as he did. My mother, a rather vain and timid creature

promptly agreed, for she had too often observed that my father's displeasure resulted in severe injury or death to those who incurred it. When, therefore, the ring was complete and the shooters advanced to bag their prey, my parents arose as one man, and, uttering the most frightful roars, charged the circle at the weakest point and got clear away, after inflicting various wounds in the legs of the surrounding elephants. They did not halt in their wild career, till they crossed the river boundary of their native country and lay panting in a jáman grove in British India. And they then and there decided that their native country was not good enough, and that they preferred to pass the rest of their days in a locality where it was utterly impossible to collect 200 or even 50 elephants. Thus it happened that I was born in British India and here, I must remark, that it is a poor country, for in the first place they protect the forests from fire, so that it is almost impossible to catch a deer, unless you have the speed of a greyhound and can course him in the open, and secondly because the jungles are full of forest officers, who if they do not themselves shoot, invite others to do it for them, and to this end train up their servants to notice each foot mark inadvertently left on a sandy path. Still, with these evils ever present, at least you are not surrounded and obliged to fight for your life. A little caution and an escape by flight is always open to you. The three happiest years of my life were spent with my doting parents. I had, during that time, absolutely no cares, food was plentiful and danger did not exist, when two experienced tigers were for ever on the look-out. But one unlucky day, I incurred my father's displeasure. I inadvertently annexed a bone which he had put aside as a tooth pick after a full meal on a spotted stag, and he struck me a blow on the head which was instantly followed by oblivion. When I awoke, I was alone, and soon became aware that I had been left to my own resources. This, however, did not discourage me, for I was well able to provide myself and after an exhaustive survey of the vicinity, I fixed my head quarters in the neighbourhood of a forest bungalow, whence should venison fail me, I could always make a raid on the cattle which grazed around. It was on such an occasion that, late in the afternoon, I had struck down and dragged to cover a large buffalo, but unfortunately the noise of the inevitable scuffle at once attracted the attention of the owner, who rushing off to the Forest House, gave news to the Europeans there. In a very short time three or four men arrived and surveyed my prize, and though I prevented them by incessantly growling, from removing the buffalo, they nevertheless insisted in climbing a neighbouring tree, where they remained for some time for some inexplicable reason. Towards nightfall, however, they came down from their perch and walked hurriedly away, whilst faint with hunger, I advanced to the kill, determined to make a hearty meal. No sooner had I reached the carcase, when I felt a blow in my side, which threw me off my balance and in the same instant a loud explosion rent the air. I lay groaning

with rage and pain, filled with an indescribable longing to tear something to pieces, and waited till some sound should disclose my enemy. It seemed ages before I heard a slight noise in that fatal tree and a voice softly whispered "he is now dead, let us get out of *this* ! a remark which was instantly followed by a loud shout and the approaching footsteps of an elephant. The whole treachery of man was now apparent to me and I recognized that I had been, perhaps, mortally wounded by some miserable wretches who, seated far out of reach, had shot me as soon as I approached the kill. In the confusion and bustle which followed the arrival of the elephant, I staggered a short distance away and congratulated myself when I saw the sportsmen depart promising to bring in my corpse in the morning. At that time, however, I was miles away. First dragging my aching body to the nearest pool I cooled my wound and stopped the bleeding by rolling on its clayey banks and then, leaving no bloody trail, I slowly reached the gloomy recesses of the great tree jungle and rested, determined to sell my life dearly if further pursued. For weeks I hung between life and death, reduced to a skeleton by the pain of my wound and the constant pangs of hunger. I roamed, the ghost of my former self, through my old haunts, forced to exist on all kinds of food I once despised, since I had no strength to kill deer or cattle. It was not till the following winter, that I took a turn for the better and became myself once more but changed from a careless frolicking young tiger, to a circumspect and experienced animal who knew that length of life depended on self restraint and caution. The narrator here paused and the younger tiger gave vent to a sigh of impatience. "Perhaps, he said, to his companion, when you have got your breath again, you will tell me why this wearisome tale is inflicted on me ? The other appeared somewhat vexed at the discourteous speech but quietly answered, "Because, my friend, there is a human being armed with several guns in that jáman tree just over your buffalo and though I am screened from his fire by this tree trunk, you are full in view." The younger tiger with one frantic bound sheltered himself behind his cynical friend and after a while breathlessly exclaimed "I don't believe a word of it, I can see nothing." With a low chuckle, the other gave answer "Had you not believed what I said, why show such agility in changing your position and if you still disbelieve, why not walk up and see how your buffalo is getting on." The junior made no reply and the old tiger went on. "I have lived to a good old age and know every device that can be brought against me by man, and yet I also know that some day I shall fall a victim to my own carelessness or neglect; it was to save your life I have spent the best part of a hot evening here, not because I admire you or your temper, but because we shall soon disappear as a race unless young fools will learn to profit by the experience of their elders. The story of my life you will not let me complete but I have a few more remarks

to make and they shall be to the point. Always keep near your kill; if it is visited by man, desert it at once and for ever. Never wait for the near approach of an elephant; however unpleasant it may be, always retire as soon as you hear one in the vicinity. Do not annoy human beings, you will be classified as a dangerous pest and your destruction is certain. Finally, cultivate a more courteous disposition and take well-meant advice in the spirit it is offered. With that he arose and instantly disappeared in the neighbouring grass. The younger tiger muttering something about "old fool" and "dotage" slunk cautiously away and was lost to sight amongst the gloomy trees. Meanwhile I, the occupant of the "Machan," got entranced at this marvellous occurrence and thankful that I was safe up a tree, composed myself to pass the few remaining hours of darkness. I awoke when the earliest dawn was faintly visible over the distant forest and my first glance was for the buffalo. It was gone! This then, said I to myself, is the result of sleeping at your post and dreaming idle dreams when you should have been on the watch. I looked cautiously around and guided by a sound suggestive of bone crushing, made out dimly, in the feeble light, a group at about 40 yards' distance. It was indistinct and blurred, but the fast-coming day made it every moment clearer, and as the morning sun topped the highest trees and shone over the lake, raising little wreaths of mist from its shiny depths, it shone also on a fine young male tiger who arose from the scattered remains of the dead buffalo to greet the commencement of a new day. After all the serious talk of last night, I murmured, so much was my brain still confused with facts and visions, after all those solemn warnings, the brute has yet risked life for greed. And forthwith a cloud of smoke was belched from my leafy recess and the forests rang and re-echoed with the sharp report. The air was full of the alarm notes of forest birds and animals thus rudely startled, whilst two quick short roars to my right and the hasty movement in the heavy grass there, told me that another tiger must have been witness of the scene just enacted. I waited for him to break in the open and so gain his forest retreat but in this I was disappointed, for after a lapse of several minutes, I saw him slowly and majestically stalk out of the deep grass some 300 yards off and walk up the steep bank into the Sâl forest whilst the convulsive twitch of his tail, as he disappeared, intimated that he was silently chuckling at having disappointed a sportsman for the hundredth time. As for his companion, on the shot being fired which had struck him full on the chest, he had reared straight up on his hind legs and beating the air furiously with his paws had fallen dead amongst the *débris* of his repast.

O. C.

The Sanitary Effects of Woodlands.

For us to realise the effects of woodlands upon public health we must first notice the conditions found in a wooded country, and the changes that happen, as it becomes cleared. From this we may, to some extent, retrace the process that takes place, when a region, wholly cleared and rendered insalubrious in some countries by the malaria that has been produced by the change, is restored by due and proper planting to its former healthy state.

A country wholly covered with forest is undoubtedly cold and humid in temperate climates; it is often infested with deadly fevers in the torrid zone. The climate of ancient Gaul must have been very different in the days of Julius Cæsar from that of France as it is to-day.

It is not unusual to notice the occurrence of intermittent fevers as a wooded country first comes to be cleared up and brought under cultivation. The "Genesee Country," and the level and somewhat swampy lands of some parts of Ohio, and other Western States, gave them a very bad reputation in the early days of settlement. A men who owned a farm on the site of Cleveland, about 1818, has told the writer that he would not have stayed in that region if the whole of it had been given to him. But the most or all of these sickly regions of an early day have long since not only regained their credit, but are now regarded as quite salubrious throughout the year. The decaying wood and other vegetation which, when first turned up by the plough, loaded the atmosphere with unwholesome vapours, has long since wholly decayed, and swamps have been drained; stagnant waters no longer dry away under a hot summer sun, the causes of this sickness no longer exist.

In some countries, as in Italy, excessive and persistent insalubrity has been brought on not by the clearing of woodlands, but by another process. As the forests upon the mountains were cut away, the soil becomes exposed to torrents, and great quantities of material were washed into the valleys. The coarsest and heaviest part was left in the intervals, often rendering them sterile and uninhabitable; the finest part was carried down toward the mouths of the rivers, which they choked up, closing their channels to commerce, and causing lagoons. These have rendered a once healthy and densely-populated country in some parts almost uninhabitable. The

"Maremma" of Tuscany, along the coast between Leghorn and Civita Vecchia, and the "Campagna" around Rome, are examples of this change. The Government has done much towards improving the former, by drainage, and by dykes for preventing the mingling of fresh and salt water; and an enterprising corporation, under the patronage of Government, has made a splendid beginning in the latter, of which we will now speak.

The Abbey of Tre-Fontane, but three miles south of Rome, was built on the spot where, according to tradition, St. Paul was beheaded, and for many centuries was regarded as in a healthy region. It is a gently rolling country, wholly devoid of trees, fertile enough for cultivation, but for a long time so sickly that the place was given up for habitation, and came to be called "the tomb." Mrs. Jameson, in her book entitled "Sacred and Legendary Art," thus describes it:

"In all the melancholy vicinity of Rome there is not a more melancholy spot than the Tre-Fontane. A splendid monastery, rich with the offerings of all Christendom, once existed there; the ravages of that mysterious scourge of the Campagna, the malaria, have rendered it a desert. Three ancient churches and some ruins still exist, and a few pale monks wander about the swampy, dismal confines in which they stand. In winter you approach them through a quagmire; in summer you dare not breathe in their pestilential vicinity; and yet there is a sort of dead beauty about the place, something hallowed as well as sad, which seizes upon the fancy. . . . . . . The ancient frescoes have perished, and the modern ones are perishing. It is a melancholy spot."

The reputation that the eucalyptus had gained as a disinfectant in malarious regions suggested the thought of trying it here. This tree, a native of Australia, grows in its native country to a vast size, even outmeasuring the giant trees of California in height, and, in favourable conditions, growing with great rapidity. Of nearly a hundred and forty species, there is not one that will endure the cold when planted elsewhere than in its native climate, although some of them there will endure a considerable degree of cold. The difference is probably due to the more thorough ripening of the wood by the warm dry summers that precede their winters. In some parts of California it grows as luxuriantly as at home: but the hot days and cold nights that sometimes occur in winter along the gulf coast prove too much for it, even through it is scarcely cold enough to freeze. In Algeria and other warm countries, it thrives wonderfully well, and the success that had attended its cultivation there led to its trial near Rome. Probably religious zeal had something to do with it, as at least worth trying in order to rescue a place that was sacred in the eyes of devout Catholics.

A brotherhood of French Trappist monks undertook the task about twenty years ago, getting three acres planted around the monastery. At first they returned to the city to sleep, but about a

dozen of the number died. The beneficial effects, however, began to appear as the trees grew, and in 1874 they ventured to sleep upon the premises. Some of them after this were taken sick, but the disease was of a mild form, and it has steadily been growing less from year to year.

In September, 1879, an agricultural company was formed by them, and a lease obtained upon easy terms, one of the conditions being that they shall plant a certain number of eucalyptus trees every year until the whole tract (494 hectares, or 1,223 acres) is under cultivation. They hire convicts from the city prison, who are paid about 20 cents a day, but not till the end of their term. The selection was made from those sentenced to ten years or more, and who had served out more than half their time. When the writer visited the place in October, 1881, there were about 150 of these men at work, and they had been planting all summer long. The trees are started in boxes, and are set without disturbing the roots. They are well watered at first, and for a year or two afterwards, and the trees are set wide apart so as to admit of cultivation of vines and grain between. There had been planted about eighty acres that season, and since then the number of labourers has been largely increased. In 1881, for the first time, the convicts were lodged upon the premises, and no inconvenience was observed. The rapidity of growth of the trees is remarkable, and, although there had been frosts that killed back the new sprouts, they budded from the older wood a little lower down, and soon recovered from the injury.

Although we cannot plant eucalyptus treees to much extent in the United States, we can at least plant other kinds that produce the most beneficial results on the public health. Whether, in that case, it be the vast amount of drainage that they secure in a spongy and retentive soil, through the evaporation from the leaves, or whether there be some specific quality in the aromatic emanations, something like what we perceive in a pine wood, is not fully known. But it has been sufficiently proved that a belt of woodland will intercept or absorb the malaria of a marshy region, whatever may be the species of which it is composed.

There can be no doubt but that the coolness and freshness imparted to the atmosphere by a grove of trees in summer is conducive to health; and that to have parks and plantations in cities and upon private grounds is as salubrious as it is agreeable to the senses and tranquillizing to the mind.

It is only in recent years that our city authorities have begun to appreciate the importance of parks, and to notice the opportunities offered by a wild, rocky suburb, a neglected and barren common, a river bank, a shore, an island, or a point of land which, at a small cost, may be turned into a paradise of beauty, a health resort to the citizens, and an inviting place of rest. In planting trees round a dwelling, it should be remembered that fresh air and sunshine are essential to health, and that for this reason they

should not stand too near nor too close. It will also be found that some trees, like the ailanthus, emit a nauseating odour in blossom, and that a judicious choice of kinds will greatly affect the result of growth. It would not be worth while to spend time and money in planting the chestnut in a limestone soil, or the oak or maple in a light sand, or the pine in a heavy clay soil. By carefully observing the conditions in which the native trees thrive best, we can infer what is best for them. But where exposed to the dust and smoke of cities, our choice must be limited to a smaller number.

But in summing up the results, omitting altogether the commercial values of wood, we find ourselves largely indebted to the groves and woodlands for an infinite amount of human happiness. In all time since man, according to Scripture, was first placed in a garden abounding in all manner of trees, bearing goodly fruit, down to the present time, we find them in one way or another ministering to his comfort and his health. In youth we hail the approach of spring, with its expanding foliage and the opening blossoms of the trees, as the gladdest season of the year. It is the symbol of hope, and the promise of happiness to come.

In middle life, when worn down with the cares of business, with mental labour, or with physical toil, we find no remedy so grateful as the summer shade and the quite rest of a woodland retreat. It is health-inspiring and renovating to an incomparable degree, and is often prescribed by skilful physicians where other remedies would fail.

As the season advances, we find a fitting symbol of the approach of age in the ripening fruits and the golden hues of the declining years. Let us, then, provide refreshing groves within easy distance from the homes of our labouring poor, in our cities and villages, and such as have opportunity, upon the grounds around our dwellings.

If we would realise the luxury of these surroundings, we have but to imagine what life would be without them. If there be a term in language that expresses everything that is desolate and dismal, it is that of "*a treeless waste.*"—(*Franklin B. Hough in Timber Trades Journal*).

Paper From Timber.

In none of the mechanical arts has greater progress been made in recent years than in the manufacture of book and magazine paper, many tons of which are used every month. Years ago, though not too long to endure in the memory of "the trade," the process of converting the raw material into the hard-fibred and smooth-surfaced paper essential to the needs of the higher class publishing houses, was a task involving many days of constant care and much manual labor. To-day the progress

is extremely rapid, the paper is infinitely better, and much of the manual labor that was employed in the days of our fathers has been supplanted by labyrinths of swift moving machinery.

It would be difficult to imagine, says the *Manufacturer and Builder*, a more surprising metamorphosis than that by which the native timber of the Pennsylvania hills is converted, in seven hours, to a sheet of clear white paper ready for the press. Yet this, in brief, is the process that is going on every day at the New York and Pennsylvania Co's mill at Johnsonburg, in Western Pennsylvania. This mill is the largest paper making establishment in the world. It covers several acres of ground, and almost as many acres of machinery. Sixty cords of wood are thrust into the choppers and 90,000 pounds of paper are shipped from the yards every day to be cut, printed, and placed on countless libraries throughout the land.

The chopper, where the conversion of wood into paper begins, is a short guillotine. There is a sharp blade, of massive proportions, moving swiftly in a groove. Everything that comes beneath the knife is severed. Occasionally, a tough knot that has withstood the blasts of many a winter is tossed in, only to suffer the fate of the sapling that went before. Every stick that goes in comes out in the shape of chips no larger than the palm of a man's hand. The wood does not lose its identity, however, until the next stage in the process, which is known as "cooking." There are several large digesters, containing caustic soda, in which the chopped wood is placed and cooked for five hours, this being the longest single process to which it is subjected. From the digesters it is blown into a large tank, its consistency being thick and heavy, and the color an ugly brown.

The soda having been run out, the pulpy cooked wood in the tank is washed down with hot water and thoroughly cleaned. Then it is dumped into a large chest, cleaned again, and, having been pumped into a screen which removes splinters and *débris*, it is run into wet machines and in a measure dried. The "stock" emerges from these machines an unbroken sheet of light brown pulp, resembling soaked birch bark. As it falls from the machines it is taken on, carried to four bleachers, each holding 4,000 pounds. Here it is treated with chloride of lime liquors until the desired whiteness is obtained.

By this time one begins to see how it is possible to make paper from wood, for the "stock" has already assumed a beautiful white color, and its consistancy is of a soft pulpy sort, very much like boiled starch, and not at all like wood. Squeezed in the hand, however, there remains a dense fibre that clearly shows the stuff of which paper is made, and establishes the link that binds the pulp in the tank to its parent timber on the neighbouring hills.

A pulsometer pump close by the bleachers, next drives the white mass into fifteen large store chests, each holding 8,000 pounds. It is held in the chests, until the beating engines are ready to give

it a shaking up preparatory to it final transition. The stock, which is now called "half stock," receives its coloring material and sizing. If blue, yellow, pink, or any other color is desired, this is the stage in the process where the coloring material is supplied. The "sizing," which consists of resin and an alkali boiled together, is used to give the paper the desired resistance to atmostpheric influence. An alum is used, which separates the alkali from the resin in minute particles, and while passing through the callenders or the paper machines it fuses, thereby completely covering the sheet with a film, which effectually resists the influences of the atmosphere. Clays are used to make the paper opaque.

From the beaters the "half stock" is passed into a large chest holding 4,000 pounds, containing an agitator turning at the rate of twelve revolutions a minute and thus keeping the stock in a uniform condition preparatory to its passage to the refining engines. These engines, two in number, supply 106 inch paper machines, which marks the beginning of the metamorphosis. Having passed through a sand catcher to a receiver or mixing box, the stock finds its way to the great Fourdrinier machines. Still in a liquid state, it is passed to an endless wire screen and a vibrator where the water is then taken from the partially formed paper by means of three suction pumps. This screen contains seventy meshes to the square inch, and is forty feet long. By the time the stock leaves the screen, its transition to the paper state is clearly defined, through there is still a long line of humming machinery through which it has to pass. The primary stages, however, are over.

A ten-inch "dandy" roller now gives the paper the same shape and surface on both sides, and, if necessary, supplies it with the water mark. Then it passes to two couch rolls covered with woollen jackets, and then to a thirty-two foot endless Bredt wet felt, where the remaining water is pretty effectually pressed out. As there is some water remaining, another felt press is resorted to, and then the paper is ready for the drying cylinders, fifteen of which, each 48 inches in diameter and heated by steam, relieve the paper of the last of its moisture. A cloud of steam rising from these cylinders as they slowly revolve with their white coverings shows that some moisture still remains. But the cloud grows less and less dense as the last of the cylinders is reached, and by the time the paper reaches the callenders it is as dry as a bone. These callenders are chilled iron rollers, which give the paper its desired finish. From these it passes to six revolving reels, and then to the cutting machines, where it is cut in any shape or size preparatory to shipment. While this interesting process is going on, the caustic soda used in cooking the wood originally is by no means forgotten. The soda is somewhat expensive, and about 65,000 pounds of it would be lost every day, if it was not recovered. Accordingly it is drained through the bottom of the tanks, to be subjected to a remarkable series of processes which eventually restore it to its original condition and to 90 per cent of its original volume.—*(Indian Agricultuirst.)*

World's Fair Notes.

India has sent one of the most charming collections of woods it has ever been the pleasure of any one to see. These are being polished and prepared for the space allotted to that country. New South Wales has a very large and charming collection of woods rich and rare, these are being polished and put in place, as are also the alleged to be un-wear-out-able paving blocks from Australia; but the States of Illinois and Nebraska are the first on the grounds with elaborate collections of native woods, and if any one supposes that walnut finish is a lost art, he need only to look at some of the mammoth specimens of walnut from the State of Nebraska and to see the beautiful, polished specimens of the same wood and others, and he will change his mind very quickly. California's red wood, cedar, and other specimens are entirely worthy of the forests of the Pacific Coast, and many other specimens from foreign and domestic States are expected very shortly.

English Oak for the Chicago Exhibition.—Messrs. Hampton & Sons, of Pall Mall East, and Cockspur Street, London, have prepared some remarkable work for the Chicago Exhibition. By permission of Lord Salisbury, they have made a facsimile of the historic banqueting hall at Hatfield House, and are thus able to send to the New World an unique specimen of English art as it was in the sixteenth century. Some idea of the labour involved may be inferred when it is said that the reproduction is 44 ft. by 22 ft., and lofty in proportion, that it is constructed, internally, of oak alone, and that almost every inch is covered with work. In proceeding to carry out their design, Messrs. Hampton sent down a staff of artists, who took casts of the fantastically carved figures, and made drawings of all the panels and traceries, and these have now all been faithfully reproduced. With the exception that the new hall is slightly smaller than the original, the Americans will be able to see an exact representation of a famous hall in one of the most historic of English houses.

Ceylon.—Ceylon will make an unique exhibit at the World's Fair. The floor of the building it will erect will consist of Ceylon woods. The pillars, capitals, and carvings will all be reproductions of original objects in the ancient cities of Ceylon, and these will all be worked in ironwood, ebony, and satinwood. The gradations of colouring in the carved pillars will be striking. The shading is from the pale crimson yellow of satinwood to the warm orange brown of the jakwood and the darker tints of margosa, palm, and Kumbuk and old root-stem wood of the tamarind are beautiful in their markings. Abundance of light to reveal the beauties of carvings and traceries in the building is to be secured by a large number of windows with beautifully-carved frames. One of these window-frames will be a reproduction of the stone window from the palace at Yarabu. The building is to cost about 30,000 dols.—*Timber Trades Journal.*

Notes on the Climatic Influence of Forests.

While writers on forestry and friends of the Forestry movement have been advocating reform in the public treatment of forests on the ground of their conjectured climatic importance, a thorough investigation of the question by scientific methods and careful systematic measurements has been made in Europe, where well established Forest Administrations rendered possible such work on an extensive scale—such a scale as is necessary for conclusive results.

The question of practical importance is not so much as to the effects of the forest upon the general climate, but as to the local modification of climatic conditions produced thereby. We are not concerned as to whether the total rainfall over the continent is increased, but whether the distribution of precipitation in time and quantity over and near a forest area is influenced by its existence; whether we or our crops feel its absence or presence in our immediate neighbourhood.

We can readily understand that an effect upon climate, if any, must be due, in the first place, to the mechanical obstruction which the forest cover presents to the passage of air currents and to the action of the sun's rays upon the soil ; that it must result from a difference in insolation and consequent differences in temperature and evaporation over forest and field ; and that this influence can become appreciable only when large enough air columns of different characters are opposed to each other, capable of producing local currents of air which may intercommunicate the characteristics of one area to the other, or else of changing the character of passing air currents. The size and character of the forest-growth, its density, height, situation and composition are much more important in determining its influence than has been hitherto supposed. It is not trees but masses of foliage, which may be effective.

The most important contributions toward a solution of the question of climatic forest influences are the observations at three sets of forest meteorological stations, established in Switzerland, Germany and Austria. The systems, made up of double stations, one within, the other without, the forest, but under similar conditions, otherwise cannot finally decide the question of the climatic influence of the forest, but they may furnish preliminary data in establishing the differences between meteorological conditions in the Forest and in the open, from which finally the reaction of one upon the other may be deduced with the aid of additional observations in radial stations, such as have been more recently established in Austria.

The observations in the forest meteorological stations of the Canton Berne, lately published, comprise nineteen years at three sets of stations, the largest systematic series of observations so far

recorded. Only the temperature observations of air, soil and tree-interior are so far published with results which permit of the following conclusions. The air temperatures taken three metres above ground are found in the forest lower for mean annual as well as mean monthly, except during winter months. The difference is greater at 4 p.m. (time of daily maximum) than at 9 a.m., and increases as the season temperature increases, reaching its maximum in July, then decreasing toward fall; in winter the air temperature in the woods is nearly the same as in the open, or, at least, only slightly warmer. The evergreen forest seems to exert greater cooling influence than the Beech-woods. Altogether, the range of temperatures through the year is from two and a half to three degrees, Fahrenheit, greater in the open.

The soil surface in the open in Summer is warmer, in winter colder than the air; in the forest, on the contrary, the surface temperature is always lower than the air temperature, and the forest-soil shows at all depths during spring, summer and autumn lower temperatures, but in winter either the same or slightly warmer than the open. The greatest difference is found at the surface, the Spruce forest at Berne exhibiting the greatest cooling effect to the extent of nine degrees Fahrenheit while the warming effect in winter ranges only from one to two degrees.

At 9 a.m. no difference was found between temperatures breast-high and in the crown of the trees, but at 4 o'clock the crown shows higher temperature, except in winter, when it is as cold as, or colder than, the lower parts. The trees are always colder than the surrounding air and colder than the air in the open especially in summer. This may be one of the factors which help to cool the air temperature in the forest and possibly induce condensation of moisture-laden air currents. The range of tree temperatures is smaller than that of air temperatures.

From the observations at the German Stations sixteen in number, which extend through now eighteen years, the most interesting result regarding forest influence upon rainfall, may be cited at the station of Lintzel. This station is situated in the great Lueneburg heath, a prairie-like country, which during the existence of the stations, has been reforested, so that on, an area of twenty-five square miles the following change took place:—

	Before reforestation.		After reforestation.
Field and meadow,	12 per cent.	...	10 per cent.
Heath	85 ,,	...	10 ,,
Forest	3 ,, (old)	...	80 ,,

The reforestation took place at the rate of 1,000 to 1,500 acres a year at first, afterwards more slowly, until 8,000 acres were under forest.

Comparing the rainfall observations with those from stations outside the forest conditions, but near enough to be available for

comparison, the following changes took place at Lintzel. While at first the rainfall was only about eighty per cent of that at the other stations, it increased as follows :—

1882.	1883.	1884.	1885.	1886.	1887.	1888.
81·3	86·3	95·2	99·8	100·6	103·7	103·9

So that finally it rose from a deficiency of nearly twenty per cent. to an excess of nearly four per cent.

The observations at the Austrian Stations cover a period of eight years. These stations, of which there are three sets, are radial, that is to say, there are several sets of instruments in the open at varying distances and in different directions from the forest, by which arrangement, it is to be hoped, not only the difference of meteorological conditions, but also the influence, if any, of forest areas may be determined. These observations are especially valuable, because they have been taken at various heights above the soil, and, therefore, indicate the differences in vertical distribution of these meteorological factors of temperature and moisture. Comparing the air temperatures of forest and field at the same height above, the soil, namely at sixteen, thirty-six and forty-eight feet, we find in the day time the same temperature, lower below, higher above the crowns than at corresponding heights in the open, while in the night, the temperature in and above the crowns is lower. Yet the differences are not very great.

The absolute humidity is always greater in and above the forest. This excess is smallest towards morning and reaches its maximum at noon, then decreases again. The difference at noon is 0·55—0·63 inches, with calm air. The relative humidity at all heights and at all times is higher in the forest, the difference in calm weather at sixteen feet reaching as high as thirteen to thirteen and a half per cent. in the mean of observations. At forty-eight feet it is less, yet in the hours towards morning it is still ten and nine-tenths per cent greater than over the open. In regard to the humidity of the air, it is noteworthy that in the forest the relative humidity increases and decreases at the same time with the absolute humidity, while usually in the field they have opposite progressions. This leads to the conclusion that the forest is at the same time a source of atmospheric water-supply and of cooling. Since on the open the water-supplies under the influence of higher temperatures and unchecked winds, are more readily exhausted or reduced to a minimum where evaporation and transpiration of the soil covering plants does not increase proportionaly to temperature increase, it becomes evident that the forest retains for a longer time a water-supply which is easily available.

The observation that both absolute and relative humidity are increased in the forest is a new and important fact, which had not been apparent from the observations of the German Stations situated under the influence of an oceanic (the Baltic and Atlantic) climate, which is characterized by high relative humidity and only

occasional high temperatures, while the Austrian stations are situated near the region of the pontic dry climate. In such a climate the dry air is capable of taking up additional water-supplies from the forest, and since the latter has also a cooling effect, both absolute and relative humidity of air currents passing it are increased, while in the oceanic climate the absolute moisture, already high, cannot be increased, and only the cooling effect of the forest affects the relative humidity. This important difference in general climatic conditions must be kept in view when discussing forest influences. In comparing forest and open field, the kind of cover of the latter must also be taken into account. During the early development of meadow-growth and of crops, while they are green they furnish by transpiration more water to the air than the forest. Since, therefore, during this season the open soil loses both by evaporation and transpiration more water than the shaded forest soil, the latter is able to supply moisture when that of the field soil is exhausted and begins to absorb moisture from the atmosphere, especially when, with the ripening of the crops, the plants cease to transpire much water. Hence, the difference of absolute humidity appears greater in the forest, especially in dry seasons.

The decrease in absolute humidity above the forest crown must, of course, take place at about the same ratio as above the field, but altogether the observations seem to show that the enriching of the air with moisture above a forest cover can extend to a considerable height. These conditions of moisture and temperature above the forest, lend countenance to the claim that the possibility of precipitation over large and dense forest areas is greater than over open fields.

As far as temperature and moisture conditions of forest areas may be communicated to adoining fields, further light is promised from the radial stations in Austria. The results from these have only just been published, and I will refer to them at same other time. Theoretically, there are various objections to the assumption that the influence, if any, is an appreciable one. But we know that meteorological theories, more than others, are liable to be at fault and unsatisfactory in many respects, probably on account not only of the complicated nature of the phenomena with which they deal, but also of the defects in methods and means by which the data have, so far, been collected.

It is hardly a conclusion, but at least an impression, that seems to come from looking at results already presented that, as a climatic factor, the forest of the plain is apparently of more importance than the mountain forest, the more potent meteorological influences of the mountain elevation obscuring and reducing in significance the influence of their cover, while for soil and water conditions the mountain forest is of considerable importance.

(B. E. FERNOW, *in "Garden aud Forest."*)

THE

INDIAN FORESTER.

Vol. XIX.] **July, 1893.** **[No 7.**

A tour in Jaunsar.

Every year, in the months of April and May, the students of the Imperial Forest School, Dehra Dún, are taken on tour through the forests of the Jaunsar Division in the School Circle, which comprises the Reserved Forests in the Government Estate of Jaunsar and the Leased Forests in part of Tehri-Garhwal. There are many matters of great interest to be seen in these forests ; in Forestry there is the natural reproduction of deodar, blue pine, long-leaved pine and oak, as well as the artificial reproduction of all these trees and especially deodar, also the working of the forests under their working plans framed by Mr. N. Hearle, Deputy Conservator of Forests ; in Forest Engineering there are hill roads and the works connected with them, the timber sledge roads of Thadiar, Deota and Bamsu, suspension and girder bridges, river-training works, &c. ; while the Botany of the tour which occurs at the time when most of the chief trees and shrubs are in flower, is most interesting.

For several years, it has been the custom to prepare journals of these tours and in this way the following have been printed and published at various times and some them are still available at the School.

For	1885	prepared by Mr.	W. R. Fisher.
„	1886	„ „ „	A. F. Broun.
„	1887	„ „ „	W. R. Fisher.
„	1888	„ „ „	A. Smythies.
„	1891	„ „ „	C. G. Rogers.

while that for 1892 is in manuscript prepared by Baboo Upendranath Kanjilal. It is unfortunate that those for 1889 and 1890 were omitted. In the following notes which Mr. A Smythies has put together, much of the information contained in these various journals has been incorporated with observations made during the tour of 1893 ; and as it is believed that the account of the works visited is likely to be of interest to readers of the Forester we have decided to publish them in our pages.

HONY. EDITOR.

FORESTS NEAR CHAKRATA: April 12 to 18.

Roll call at Morrow's Neck at 8 a. m. In the afternoon we inspected the Fuel and Timber sheds in the Depôt. The old Fuel shed is 146 ft. long and 40 ft. wide. It is entirely built of wood, the original cost being Rs. 5,000, exclusive of the price of the timber. It is divided into 7 compartments, each 20 ft. long. The stack of fuel at the outside near the wall is 8 ft. high. The next is 10 ft. the next $11\frac{1}{2}$ft., the next 14 ft., and the next 16 ft. There are 5 stacks in the middle, each 18 ft. high, and a similar descending series on the other side. Each stack is 20 ft. long and 2 ft. wide. Thus the contents of a compartment

$$= 2 \times 20 \left\{ 2\,(8+10+11\tfrac{1}{2}+14+16)+5\times 18 \right\}$$
$$= 8{,}360 \text{ st. cu. ft.}$$

Therefore the contents of the whole shed

$$= 7 \times 8{,}360 = 58,\,520 \text{ st. cu. ft.}$$

Oak and fir are stacked separately, and the fuel is issued to the Commissariat Department by measurement, not by weight. There are many reasons for this. First of all, the weight of fuel is never constant; it may be green when it comes in from the forest, and it dries slowly in the shed; but during the rains, it is quite possible that it absorbs moisture to the extent of 15 or 20 per cent of its dry weight and loses it again during the next dry season. Moreover, it would be almost impossible to weigh out such a large quantity of fuel as the Commissariat requires which amounts to 140,000 st. c. ft. every year.

The connection between measurement and weight of Chakrata fuel has been found out by experiments, and stands thus:—

230 st. c. ft. of oak fuel weigh 100 maunds
320 „ „ fir „ „ 100 „

It has been further ascertained that for this kind of fuel, 100 st. cu. ft. are equivalent to 66 solid cubic ft. The present selling price to the Commissariat is Rs. 17 per 100 st. cu. ft. of fir and Rs. 25 per 100 st. cu. ft. of oak.

A small fuel shed has been built to contain fuel sold to the general public, and to keep it dry during winter and the rains. The stacks in this shed contain 50 cu. ft. each and they are sold at Rs. 5/8 each. Besides this there are faggots of Indigofera and other woody shrubs, 2 ft. long and 2 ft. in diameter which are sold at 3 annas a bundle.

The Parade Ground Fuel Shed. This fuel shed is similar in construction to the one at the depôt and the pitch of the roof is 42° 30′. We saw fuel from the Korwa and Kalsi coppices being stacked in this shed. The Kalsi fuel consists chiefly of sal, sain, bakli, dhaura, kusam, haldu, jamun, raini and amaltas. Jhingan, kharpat and other inferior kinds are not brought to Chakrata, but are converted into charcoal on the spot. In connection with the shed is a dry shoot about 50 ft. long with a slope of 34°. Carts

are unloaded at the head of the shoot and the fuel is shot down. The following are the rates for Kalsi fuel:—

Felling, cutting up and stacking ...	Rs.	2 0	per 100 st. c. ft.
Carriage to roadside	„	0 8	„ „
„ to Chakrata	„	15 12	„ „
Stacking in shed	„	0 3	„ „
Total Expenditure	Rs.	18 7	„ „
Selling rate	„	25 0	„ „
Therefore profit.	„	6 9	„ „

From the Korwa coppice only oak fuel is brought to Chakrata, the rhododendron and ayar being sold to the Brewery. The following are the rates for the Korwa fuel:—

Felling, cutting up and stacking ...	Rs.	2 0	per 100 st. c. ft.
Carriage by mules	„	10 14	„ „
Stacking in shed	„	0 3	„ „
Total Expenditure	Rs.	12 7	„ „
Selling rate	„	27 0	„ „
Therefore profit	„	14 9	

but Korwa is only 8 miles away, while Kalsi is 26.

The Timber Shed at the Depôt.—This is a wooden building with two storeys, and timber of the same description and scantling is, as far as possible, stacked in one place. In the lower storey there is a frame work supported on posts on which all the timber is placed, nothing being put on the ground. There are scantlings and planks of deodar and fir of nearly 130 different sizes, besides odds-and-ends of miscellaneous species. As an exercise, the students were told off in sections and counted the whole of the stock. First class deodar scantlings are sold to the Executive Engineer, Military Works, at Rs. 1-12 per cubic ft.; second class pieces are sold at Rs. 1-6 per cubic ft., generally to private persons. First and second class planks sell at Rs. 1-8 and Rs. 1-4 per cubic ft. respectively.

The system of marking scantlings is as follows. A circle with a broad arrow inside called the 'pass' mark, is stamped on each piece. Besides this, three figures are stamped on each scantling; the first indicates the length in feet, the second the breadth in inches, and the third the thickness in inches. Thus the figures 12 12 1 on a plank would mean that it is 12 ft. long, 12 inches broad and 1 inch thick. At present all the deodar timber comes from the Karamba forest near Mundali, about 16 miles from Chakrata. It is carried entirely on men's backs, the weight of a load being about 1½ maunds. The value of timber in the shed is from Rs. 10,000 to Rs. 12,000.

The Cantonment Forest Blocks.

The Cantonment of Chakrata was founded in 1865, when the forests lying on the slopes of the Chakrata ridge came into the hands of the Cantonment authorities and the two Blocks which were handed over for treatment to the Forest Department form one Working Circle under the plan.

In 1880, these two blocks were taken over, *viz.* Lurli with an area of 290 acres, and Suitoli with an area of 188 acres. They are both demarcated with masonry pillars numbered consecutively, and are treated exactly like reserved forests, with this exception, that any surplus revenue, after paying for maintenance and planting operations, is handed over to the Cantonment authorities. Up to date the surplus revenue has been about Rs. 1,305.

They are situated in the zone of the Ban oak (*Quercus incana*), the elevation varies between six and seven thousand feet, and the forest consists principally of ban oak, ayar, and buráns (*Rhododendron arboreum*), with the usual shrubs and under shrubs. In the damper ravines of Lurli we find moru oak (*Quercus dilatata*), laurels, the small ringal (*Arundinaria falcata*), maple, holly, and other species.

The Lurli block has a general westerly aspect, while that of Suitoli is easterly, the result being that the latter is much hotter and drier.

In the two blocks, about ninety acres have been, at different times, sown and planted up with deodar, blue pine, chir, moru, and ban.

The Lurli Block. This block has been closed against fire and grazing since 1880, and plantations to fill up blanks were commenced in that year. In the beginning, by way of experiment, sowing in patches, both in horizontal and vertical lines, was resorted to. We inspected the plantation of 1880-81, area about 12 acres. Deodar and blue pine were sown in patches with a little ban oak, and vacancies were filled up from time to time by plants from the nursery below the Hospital and also from patches which had too many plants in them. This continued for 3 to 4 years, and in this way 16,000 deodar plants have been put out since the original sowings. Measurements taken in this plantation at different times give the following results, as recorded in the various journals:—

		Deodar.			Blue pine.		
		ft.	in.		ft.	in.	
1885	Average height	0	9		1	7	
1886	,, ,,	1	0		1	0½	
1887	,, ,,	1	5½		3	1½	
1888	,, ,,	1	10	(720 plants)	4	0	(40 plants)
1891	,, ,,	3	6	(281 ,,)	6	10	(49 ,,)
1892	,, ,,	4	1	(589 ,,)	8	8	(71 ,,)
1893	,, ,,	4	0	(150 ,,)	9	0	(38 ,,)

The deodar plants lower down the slope are taller than those higher up near the path. Very few of the former were measured this year, otherwise the average height would certainly have been more than 4 ft. In the sowings of December 1881, the patches were arranged in vertical lines, 3 ft. one below the other, the lines being 15 ft. apart. *This system of sowing renders inspection* exceedingly troublesome, and has now been abandoned for the horizontal method. It is difficult to distinguish between the plants resulting from sowing, and those put out.

We then inspected the ban oak and chir pine plantation of 1882. 8,400 patches in horizontal lines 15 ft. apart were sown with chir and ban oak in June 1882. They both germinated well, but the ban oak subsequently died owing to the southerly aspect and to the shallow rocky soil. Of the chir pine about one half have died. The altitude of this plantation is 6,500 ft. which is the upper limit of chir pine, hence it is not expected to do well. Those which have survived are chiefly found on south-westerly aspects. Measurements made in this plantation in past years give the following results:—

			ft.	inches
1885.	Average height		0	5
1886	,, ,,		1	6
1887	,, ,,		1	6
1888	,, ,,	(738 plants)	2	2
1892	,, ,,	(274 ,,)	5	1

in 1893 two of the longest shoots were 18" each.

These plants have thoroughly established themselves and are doing fairly well.

On the same slope, above the path, 3,500 pits were sown with *deodar and blue pine in December, 1884.* It was expected that these species might thrive at a higher elevation, but they all died out, and a partial resowing was made with ban oak ; this, however, has not succeeded well, and the probability is that, at this elevation, a southerly slope is too hot for anything but chir.

We then proceeded to the slope below the hospital with a northerly aspect and fairly well covered with a forest of ban oak, and its companions. Here two plantations were made in 1882. In the one to the east of the nursery, about 6 acres in extent, 4,000 pits were planted with deodar taken from the nursery, two plants being put in each pit, and vacancies were filled up in 1885 and 1886. In the other plantation situated to the west of the nursery *near the boundary of the block below the Hospital, 8,900 pits* were prepared over an area of 12 acres and planted in July 1883, with two plants to each pit, the plants being taken partly from the nursery and partly from surplus stock from the other plantations.

The nursery from which these plants were taken contains a large number of seedlings, which will be put out next July. The nursery

is terraced, and each bed is raised, as deodar must be well drained. We noticed some of the original seedlings which had been left undisturbed in the beds; their height is three times as great as that of the transplants, owing to better soil, better cultivation, and to their roots not being injured. The original plants came from seed of 1881, which was a very good seed year. This plantation is considered a great success, and measurements made shew the following results:--

				ft.	in.
1886	Average	height	(534 plants)	0	10
1887	,,	,,		1	8
1888	,,	,,	(1500 ,,)	1	8½
1891	,,	,,	(160 ,,)	3	11
1893	,,	,,	(553 ,,)	4	0½

This year only plants out in the open were measured; those in sheltered places, *e. g.* just below the Hospital, are 8 to 10 ft. high, and if these had been included, the average would have been much higher. Last year, the average length of the annual shoots was found to be 11 inches.

In the nursery, the deodar seedlings are pricked out into nursery lines in July of the first year, the spacing being 9″ × 3″. During the first year they are shaded by grass tatties, and after about 2 years in the nursery they are from a foot to 18 inches high and are ready to be put out into the forest. They are sometimes transplanted twice in the nursery lines in order to encourage the development of bushy roots and to prevent the formation of the taproot. This year there are about 5,000 deodar plants fit for planting, of which 3,000 will be put out in Korwa, and the balance in Cantonments.

On the boundary line, near pillar No. 4, we noticed the great contrast between the Government forest and village grazing lands, the former having thick grass, and natural seedlings of ban, ayar (*Pieris ovalifolia*), rhododendron and various shrubs, the latter shewing only bare slopes cut up by innumerable small paths with the grass grazed and burnt every year, and a few lopped trees scattered here and there.

A curious fact in connection with Lurli is that we find numerous blue pine saplings self-sown, but no parent trees are known to exist in this forest. It is possible that the seed may have been blown across the valley from the heights of Matkangra—a distance of two to three miles in a straight line,—or they may have been dropped by birds.

It is in this block that the junction of the Chakrata slates and shales with the Deoban limestone takes place, and this accounts for the richness of the soil.

In all these slopes the aid given to deodar seedlings by the natural growth of ban and ayar is considerable, and shews the importance of giving young deodar some sort of lateral shelter during the first few years.

Owing to the abnormally severe winter, the spring of 1893 was very late ; we found rhododendron in full bloom, and willow, birch and ayar only just coming into leaf. One of the pines in the plantation of '80-'81 bore a cone.

The Suitoli Block.

The area of this block is 188 acres. The aspect is principally east, and the soil is much drier than in Lurli, and not so deep.

Two plantations have been made in this block. One in 1882, with an area of 15 acres ; and another one in 1884, with an area of seven acres, lower down below the path.

In the upper portion of the plantation of 1882 no less than 20,000 trees have been put out from time to time, including deodar blue pine, chir, *Quercus serrata* from Assam, twenty or thirty different kinds of eucalyptus, Assam pine, &c., all taken from surplus stock from the forest garden. The result, as far as the exotics go, has been a complete failure, the indigenous trees alone thriving fairly well.

The recorded measurements in this plantation are as follows :—

				ft.	in.
1885,	Average	height	(20 deodar)	0	11
1886,	"	"		1	6
1887,	"	"		1	10
1888,	"	"	(25 deodar)	3	6
1891,	"	"	(149 ")	3	7
1893,	"	"	(109 ")	4	6

The lower plantation was sown with chir pine, in July 1884, and partially re-sown in 1887. The measurements taken are as follows :—

				ft.	in.
1885,	Average	height		1	1
1886,	"	"		1	6
1887,	"	"		2	5
1888,	"	"	(18 plants)	4	1
1891,	"	"	(140 ")	5	8
1892,	"	"	(163 ")	5	6

The Forest Garden.

The forest garden is situated at an altitude of about 6,000 ft. on a spur running down from the dâk bungalow. Its area is 48 acres, of which 15 acres on a northerly aspect are covered with ban oak forest, the remainder consisting of undulating ground well adapted for the purpose of a nursery. It is irrigated by a canal which comes from the dhobies' ghat about half a mile away.

The object of the forest garden is to make experiments with exotic trees, and to grow fruit trees and distribute them to villagers. Vegetables were formerly cultivated for the troops, but under a recent Government Order this has now been abandoned.

The garden was made over to the Forest Department in 1881, and in 1882, about 500 fruit trees of the best kinds from Ranikhet, such as pear, apricot, apple, plum, peach, and cherry were planted, and in most cases are now bearing most excellent fruit. The

apples especially do very well, and they are readily saleable in Chakrata. The revenue varies every year according to the crop, but there is no doubt that in a very short time it will exceed the expenditure.

Each fruit tree is planted in a deep pit, filled with the very best manure. Pears have not been found to succeed, they are attacked, while unripe, by crowds of wasps and hornets.

About 180 species of exotic trees have been raised from time to time since the formation of the garden in 1881, including Australian acacias and eucalypti and conifers from Europe, China and America. The trees which have succeeded best are : *Pinus sylvestris, laricio, Pinaster*, and *Khasya*, and *Cryptomeria japonica ;* this latter has been thoroughly established in the Darjeeling district and promises to develop into a valuable timber tree. It grows very rapidly, but it will hardly grow so fast in the colder climate of Jaunsar.

The portion under forest has been divided into 5 compartments ; 3 acres were cut over in January 1885, 15 standards being left. The net profit on the wood cut was made over to the Cantonment authorities ; no wood has been cut since, as there has been no great demand for it.

Several of the pines have been planted out among the coppice shoots of the areas cut over, where they are doing well. The Eucalypti have been severely damaged by the heavy snow last winter, and there is little chance of their recovering. The Maritime pine has begun to bear cones ; and several seedlings have been raised from the cones of *Pinus Khasya*, both in Chakrata and below in Dehra Dún.

The Matkangra Oak Forest.

The Matkangra Block in the Deoban Reserved Forests forms a small special Working Circle for the provision of fuel for Military works lime-burning, and the annual yield is fixed at 4,500 stacked cubic feet yearly. As, however, the lime-burning has been stopped, the yield is now devoted to Chakrata fuel supply.

The crop consists principally of moru oak (*Q. dilatata*). The soil is rocky and reproduction is rather backward except immediately below parent trees, where dense thickets of moru seedlings have come up. To supplement the stock, two plantations were made, one above the Jadi road, the other below it.

The upper one, 25 acres in extent, was made in 1874 and planted out in 1875. In 1892, we found the average height of 154 plants to be 11 ft. 6 ins., and in 1893, the average height of 66 plants was 14 ft. 2 ins.

The lower plantation is 26 acres in extent and was planted in 1874 from seed raised in a nursery in 1872. Measurements made here give the following results :—

				ft.	ins.
1886,	Average	height	(50 plants)	6	0
1887,	"	"		8	5
1888,	"	"	(17 plants)	8	0
1892,	"	"	(94 ")	14	0
1893,	"	"	(179 ")	15	6

The old nurseries from which these plants were taken, contain trees which have been allowed to grow on undisturbed, only suppressed trees having been removed. Although on a small scale, they form a good example of an artificial pure crop of even age, 20 years old, and now about 20 feet high. The leaf canopy is complete, the lower branches have died off long since, and a thinning could now be made with advantage. The object of such a thinning would be to liberate the crowns of the future trees, *i.e.*, to give lateral space to the crowns of the dominant trees. Being a pure crop of even age the real dominant trees are at first sight hard to distinguish. Still, here and there, one tree has a wider crown than its neighbours, and a thicker stem. More room should be given to such a tree by removing one or more of those which are hemming it in. In other cases, the trees are so exactly equal that the only thing to do is to create a dominant tree artificially, as it were, *i.e.*, to select one and to remove one or more equal trees on either side. In any case the leaf canopy should be kept as close as possible.

The removal of the trees really suppressed in this case does not do much harm. As we are not dealing with a timber tree, the formation of a long clean bole free from branches is not important; moreover, the suppressed trees are saleable to make tool handles. But it should be remembered that in most cases the removal of suppressed trees is indefensible, *e.g.*, in the deodar thicket at Bodyar.

These two old nurseries in the sapling stage, are excellent examples of the necessity of making thinnings and of the great difficulty of doing so in a pure crop of even age raised artificially.

The following measurements have been made in these nurseries from time to time :—

				ft.	ins.
1886,	Average	height		8	3
1887,	,,	,,		13	6
1888,	,,	,,	about	15	0
1891,	,,	,,		17	5
1893,	,,	,,	about	20	0

The boxwood of Matkangra is found in a shady ravine called the 'Bear Garden' among large limestone rocks, in a similar situation to that of Jadi under which a description will be given.

Lower down near the Bear garden we came across a fine specimen of the horsechestnut (*Æsculus indica)*, and some of its seeds were germinating on the ground. The young leaf buds were just opening. We also saw *Rhus vernicifera* with the flower buds opening, a dense mass of purple anthers. The birch and holly were also shewn to the students.

The leaves of the Moru oak had mostly fallen, and the young foliage was just coming out in beautiful tints of olive green. The tree is never quite leafless, though the leaves remain on the tree for only 12 months. The ban oak, on the other hand, still retained most of the old leaves although the young foliage was appearing.

The Korwa Coppice.

The Korwa forest is what is known in Jaunsar as a "second class forest," *i.e.*, the villagers have certain privileges such as collecting dead leaves for manure, and dead fallen wood. The area is 130 acres, the gradient of the slopes varies from 25° to 40° and the elevation from 5,200 to 6,700 feet. The rock belongs to the Chakrata series and consists of slate and shales with a band of limestone cropping out on the lower boundary of the forest just above the cart road.

When the forest was closed in 1880, an area of 70 acres was left open for the zamíndárs of Korwa for lopping and grazing, on the condition that they should lop very lightly. It was found that they severely lopped and pollarded the trees and hacked them in every possible way. On an adjacent slope is their own zamindari forest, which they strictly protected and it is now as good as any part of the Government forest. This privilege of lopping and grazing in the 70 acres was, in consequence, taken away from them, and the whole area has been put under coppice.

Portions of this area were coppiced in 1888-89, 1889-90 and 1890-91, no standards being left, and the reproduction from coppice shoots is very promising. A blank portion of the area was unsuccessfully sown in 1887 and 1888; the aspect was south-east. As will be seen from the table below the yield from the lopped portion was very much less than that from the closed area, being in fact about one-third.

The growing stock consists chiefly of Ban (*Quercus incana*), Burans(*Rhododendron arboreum*), Ayar(*Pieris ovalifolia*), Kaiphal (*Myrica sapida*); and among the undergrowth we found *Berberis Lycium*, *Myrsine africana*, *Rosa moschata* and *Arundinaria falcata*.

The following table shows the outturn of the different coupes :—

Year of felling.	Area in acres.	No. of standards left.	Outturn in cubic feet stacked.		Compartments coppiced.	Remarks.
			Total.	Per acre.		
1881-82 ...	7	35	*8,490	1,213	2, 3, 4 (part), 8, 9, 10.	*Some charcoal was made which is not included in this.
1882-83 ...	4	30	9,470	2,367	4(part)5(part)	
1883-84 ...	3	35	7,150	2,383	5 (part), 6.	
1884-85 ...	3	55	*8,900	2,967	12	
1885-86 ...		...	...	...	11	
1886-87 ...	3	60	4,350	1,450	19	
1887-88 ...	5	60	9,940	3,313	20	
1888-89 ...	Closed 4	32	6,750	1,687	...	
	Open 2	...	750	375	...	
1889-90 ...	Open $6\frac{1}{2}$	...	5,650	904	...	
1890-91 ...	Open 3	...	2,050	683		
	Closed $2\frac{1}{3}$	54	3,820	1,530	13	

Year of felling.	Cpts. cut over.	Area in acres.	No. of standards left.	Outturn in st. cu. ft.	
				Total	per acre
1891-92	Part of 9 and 10.	1½	50	firewood 4,800 Charcoal 1,074	firewood 3,200 Charcoal 716
1892-93	15	4	148	12,417	3,104

All the oak which can be split up is stacked on the spot and will eventually be taken to Chakrata; the pieces which cannot be split are sold to the Brewery, or converted into charcoal, and the Brewery also takes all the Rhododendron and inferior fuel, at the following rates, on the spot :—Rs. 7 per 100 st. cu. ft. inferior species, and Rs. 10 for oak.

There are more standards than usual in the coupe of this year as they are of small size. The main objects in reserving standards here are to protect the soil, shed seed, and to yield a larger supply of fuel. As many of the stools are too old to produce shoots, the importance of standards as seed bearers must not be over looked. Felling on a hill side always begins at the top, in order to avoid damaging stools already cut, and to prevent the stacks of fuel being knocked down. The various coupes are separated from each other by carrying paths, and at each corner is a small stone boundary pillar. The coppice is generally cut in February and March, before the growing season begins.

The coupe of 1881-82. Aspect N, area 7 acres. The growth of the shoots in this coupe has been very good : ayar, ban and rhododendron being the most numerous, but besides these, cherry, willow, kaiphal and other shrubs have sprung up, forming a dense thicket, and an excellent cover for the soil. Measurements taken at various times are as follows :—

1885	height	3	ft.	0·5	inches	(all species)
1886	,,	2	,,	9	,,	(Ban only)
1887	,,	4	,,	5	,,	,,
1888	,,	6	,,	0	,,	,,
1890	,,	6	,,	7	,,	,,
1891	,,	6	,,	11	,,	,,

The oak and the rhododendron grow at about the same rate ; the ayar grows a good deal faster.

The coupe of 1882-83. Here too the growth is good, ban oak forming the greater part of the growing stock. Measurements are as follows :—

1885	height	2	ft.	6	inches	(all species)
1886	,,	3	,,	$3\frac{1}{2}$	,,	Ban oak only
1887	,,	4	,,	2	,,	,,
1890	,,	4	,,	1	,,	,,
1891	,,	7	,,	5	,,	,,
1893	,, about	8	,,	0	,,	,,

It can readily be understood that the Forest School Students, who can only devote one morning to the Korwa coppice, have not sufficient time to take measurements in all the different coupes—at the most, they can do some here and some there, as a practical exercise.

Other measurements taken in April 1890, show the following results for ban oak :—

Coupe of	1883—84	Average height	5	ft.	4	inches
,,	1884—85	,,	4	,,	9	,,
,,	1885—86	,,	4	,,	1	,,
,,	1886—87	,,	2	,,	2	,,
,,	1887—88	,,	1	,,	11	,,

In all these observations, it is important to measure a large number of shoots fairly disposed over the whole coupe.

In the higher portion of the forest there are large blanks, in which endeavours have been made from time to time to stock the ground by direct sowing : Australian acacias, eucalypti, blue pine, and ban oak were successively tried, but the three former failed entirely, and the latter succeeded only partially. Finally the chir pine was sown in June 1889, and the average height of the plants in 1888 was $5\frac{1}{2}''$. The total number of patches sown was 5,740 ; they were arranged in contour lines of 10′ apart, the patches being 5′ apart in the lines. The patches were 2′ long and 1′ broad, and the seed was hand-sown in a line in the middle of the patch. The number of seedlings in six patches were counted in 1888 and 298 were found alive, giving an average of nearly 50 to each patch. The patches were made by contract at a cost of annas 12 per 100; each patch is protected during the hot weather by a grass cowl of a conical shape, with a stick in the middle to support it. For the purposes of our visit, some of the cowls had been recently removed, and we noticed that the seedlings had already begun to suffer from the exposure. These cowls are taken off at the first fall of the monsoon rains in July. Each patch was prepared in such a manner as to allow the water to drain off, a precaution which is also found necessary in the case of deodar.

In spite of these precautions, the sowings, generally speaking, were a failure, and now attention is being given to deodar transplants which are raised in the Lurli nursery in Chakrata. 1,500 deodar transplants were put out in July 1892, and 500 basketted plants in March of the current year, and these all seem to be doing well. The elevation is suitable for deodar and the locality is near the market.

The Korwa forest is one of several pieces of oak forest, which are worked as a special Working Circle chiefly for the supply of fuel to the Chakrata Brewery.

CHAKRATA TO BODYAR, *viâ* JADI: April 19th and 20th.

We inspected the boxwood forest of Jadi, situated some 300 feet below the road, and found the tree in various stages of growth —from a small seedling to a full-grown tree. A good deal of damage had been done to the trees by snow avalanches. Boxwood grows naturally mixed with spruce, holly, maples and moru oak in cool shady ravines, among large rocks and boulders, and is found locally in certain places in the Himalayas, *e.g.*, in the Punjab, at Datmir on the upper Tons, near Chakrata, up the Jumna valley, and in Kumaun and British Garhwal. For the latter see *Indian Forester*, Vol. XI, No. 6, page 283. For the Punjab Boxwood see *Indian Forester*, Vol. XI, page 25. Boxwood is so valuable that it has been exported from here to England; the first lot sent, which weighed nearly 13 tons, realized £30 per ton. A second lot despatched in 1882, weighing 27 tons, realized £15 per ton. A third lot cut in the Kuphar forest on the Jumna in Tehri-Garhwal weighing 10 tons, was sent to England in 1884, and realized £20 per ton. The cost of cutting and carriage was approximately as follows :—

		Rs. per ton.
Cutting and carriage to Saharanpur and agent's charges	...	54
Rail to Karachi	...	57
Freight to London	...	38
Total	...	149
Receipts per ton	...	Rs. 328

As is well known, boxwood fetches a high price for engraving, the very best quality only being adapted for this purpose. The best boxwood is found in Persia and Turkey in Asia,

An examination of this wood, made by the writer in 1882 in the East India Docks, London, showed that the Persian boxwood is more slowly grown than the Indian variety, and is probably in consequence more close-grained.

Boxwood for the market should be in pieces three feet long, with a diameter varying from 4 to 6 inches: it should be free from knots and cracks, and in case there is liability to split, it is advisable to make a longitudinal cut with a saw from bark to centre. The Indian boxwood has, at present, rather a bad name in the market, and there is not much likelihood of its being exported to England on a large scale. A small number of trees can he sold to merchants from Amritsar, where the wood is worth Rs. 5 a maund, and is used principally in the manufacture of combs.

On this march we noticed the character of the Deoban limestone series—the peculiar weathering, and the manner in which it is dissolved under the soil by action of rain water containing carbonic acid; it is interspersed with shales of various colours, generally grey, which yield a clayey soil.

Near Jadi village, where we encamped for the night, we observed deodar trees lopped for litter and manure, and moru oak lopped for fodder. Further on, we found spruce fir lopped in the same way.

We also found good specimens of the male and female flowers of the spruce ; the pollen was not quite ripe and the scales of the young cone were, of course, open. We noticed that the cones were upright, generally near the ends of the branches. *Acer pictum* and *Buddleia paniculata* were seen in flower, as well as *Prunus Padus.*

After passing Lokandi lani, we went through a small portion of Missau 2nd class forest, open to grazing, and then went on to Bodyar.

(*to be continued.*)

The Formation of Dew.

The invitation to discuss the Formation of Dew in the pages of the *Indian Forester* was very acceptable, as I had during the past camping season given the matter some attention and arrived at certain conclusions. An aqueous deposit on foliage may be of two kinds. First, when *the moisture from the air is deposited* owing to a fall in temperature reducing the power of retention of moisture. This is what is commonly understood by "dew." Second, when moisture is deposited by transpiration of aqueous vapour from the plant itself. In either case the amount of moisture in the air is responsible for the *visible* results. In the first instance this is self evident; in the secon although the transpiration of aqueous vapour from the foliage may be actively proceeding, no deposit of moisture would take place if the air were dry. Given an atmosphere saturated with moisture, suppose a fall in temperature, then a "dew" deposit must take place on surrounding objects; but the air at the lower temperature being still saturated with moisture, evaporation cannot proceed and the *aqueous vapour given off from the foliage is deposited* as dew on the leaves. In such instances we notice dew on *both* sides of the leaf. Again given a moist but not saturated atmosphere in which little evaporation can take place, suppose a fairly equal temperature; in this case there may be no true dew deposit from the air and yet the aqueous vapour given off by the leaves may still be deposited in the foliage as dew ; we should then remark, perhaps, that the under surfaces of the leaves were studded with dew drops whilst the upper were quite dry. It is evident therefore that there may be a dew deposit on forest trees whilst there is none on the ground or elsewhere where foliage is wanting. The conditions inducing the above phenomenon are most favorable in early spring when the atmosphere is not excessively *moist and the temperature is equable. The want of* evaporative power in the air alone affects the *visible* deposit on

the leaves of aqueous vapour given off by the foliage; the transpiration of aqueous vapour from the foliage may even be greater when their is no *visible* evidence of it. It is entirely immaterial whether the moisture in the air is in "the winds that blow above" or is due to "the vapour given off by the earth below." *A true dew* deposit is only possible when at a given temperature there is an excess of moisture in the air and when this temperature is attained. *A foliage dew* deposit is only possible when the evaporative power of the atmosphere is too feeble to permit of the absorption of the aqueous vapours given off by the plant. An abnormally small dew deposit in forests is traceable therefore in reference to true dew, to an abnormal deficiency of moisture in the air, irrespective of whether such moisture is acquired at a distance or locally. A small deposit of foliage dew may be due to local drought diminishing the output of aqueous vapour from the plant, but this *must* be accompanied by a dryness in the air which, by evaporation, prevents the deposit on the leaves of such aqueous vapour as is given off. It was most interesting to note that in large areas of forest in these provinces, the Sal tree did not flower this spring. The result of this soon became apparent in a most abnormal and beautiful flush of foliage; and, with the appearance of the young leaves over hundreds of square miles of forest, the atmospheric moisture increased and the temperature fell in a very marked degree.

O. C.

Land reafforested through the intervention of Prickly Pear.

The land near the sea coast in the Bandar, Répalli and Bapatla taluks of the Kistna District is intersected by a net work of tidal salt creeks. For the most part it is very low-lying and is submerged by water from the creeks either at each high tide, or at intervals —for instance, during the rains ; and consequently it is impregnated with salt. Such land is called a "parra."

For mile after mile sometimes these 'parras' present a barren waste : in Bandar taluk, for instance, there is a stretch of 'parra' exceeding 20 miles in length, and 1½ miles in breadth. At first sight they seem hopeless for afforestation ; but, as is explained herein, this is not the case.

The first vegetation that grows on these 'parras,'—which only exists when the submersion is not daily,—consists of small trailing patches of a herbaceous-looking plant, called locally "Yilakurru." * It possesses fleshy, succulent leaves, somewhat resembling stonecrop (*Sedum*) which are salt to the taste, are used by natives for making curries, and are eaten with relish by cattle when they get used to it.

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* I have not yet been able to identify the botanical name of this plant, as I have been unable to find, so far, flowers or fruit. A. W. L.

After a time, a few patches of prickly pear are found, and once started this plant seems to spread rapidly. In the prickly pear the "Yilakurru" flourishes exceedingly; for, from a trailing herbaceous plant, it becomes a ligneous bush rising in places to 6 to 8 feet in height with a stem of 2 to 3 inches in diameter.

Then we find a grass * growing among these bushes of prickly pear and "Yilakurru", then spring up patches of two other different kinds † between the bushes; and then among the bushes of prickly pear and "Yilakurru" appear seedlings of different kinds of forest shrubs and trees, notably the following :—

Nim or vépa (*Melia indica*), Pála (*Mimusops indica*), Wulinda (*Diospyros Chloroxylon*), Uti (*Maba buxifolia*), Tella tumma (*Acacia leucophlœa*), Nalla tumma (*Acacia arabica*, where black soil is prevalent), Soapnut (*Sapindus emarginatus*), Date (*Phœnix sylvestris*) and Palmyra (*Borassus flabelliformis*),—the last three especially where the soil is sandy.

Finally, a regular scrub jungle is formed of the above-named species interspersed with prickly pear.

The prickly pear seems to form a soil of its own, possibly from its decayed leaves; for whenever the clumps of prickly pear and "Yilakurru" become at all large, it appears as if they rose from small mounds. These mounds become more and more pronounced, the larger the clumps become; and the scrub jungle is always situated on a higher level than any adjoining "parra." It may be suggested that the action is the reverse, and that the scrub jungle and higher ground is washed away by the water from the creeks; but, having considered carefully this side of the question, I examined the ground and the forest, and came to the conclusion that the scrub jungle was not eroded, but formed after the "parra."

In Repalli taluk, the gradual transition from the "parra" to the scrub jungle is completely shown.

In Bapatla taluk, one forest reserve consists of over 9,500 acres of this kind of scrub jungle, with Nim, Soapnut, Pala and other trees of about 15 feet high, with a few Palmyras scattered about. In another reserve in the same taluk, 600 acres, Palmyra and Date are more abundant than scrub. Prickly pear is still abundant in all these reserves, but it is evidently becoming subordinate to the scrub, which should be carefully kept uncut for some time longer to oust the former altogether.

The Prickly Pear has almost invariably been considered hateful to both Forester and Agriculturist, although advocates have been found for "the prickly pear as a protector to saplings" but in this case it appears to be a real benefactor.

The action of the prickly pear and "Yilakurru" between them seems to be (1) to extract the salt from the soil, (2) to render stable the mobile sandy covering of the soil, (3) to catch and protect seeds of jungle trees, (4) to form a more or less fertile soil.

A. W. LUSHINGTON. 26-5-93.

Note by Hon. Editor. 'The 'Yilakurru' is clearly a species of *Suæda* probably *S. nudiflora*. The grasses are probably (a) *Chloris barbata*, (b) *Æluropus purbescens*, and (c) *Sporobolus diander*.

* Kind (a) forwarded herewith. † Kinds (b) and (c) forwarded herewith.

Chief Forest Trees used to make Charcoal.

The Inspector General has recently sent round the following Circular. It ought to result in the collection of some valuable information on that branch of Forest Utilization.

"I have the honour to ask that you will be good enough 'to oblige me with a list of the forest trees occurring in your 'Circle, which are most highly appreciated for charcoal-burning; 'together with such information as may be available respecting 'the percentage of weight lost in conversion in the case of each 'kind of wood, whether burned in the customary local fashion or 'according to European methods. Only species which grow 'gregariously, or in quantity sufficient to render them of economic 'importance for charcoal-burning, need be mentioned; and, 'where possible, an estimate of the quantity available should be 'added."

Forest Conservancy in India.

Forestry in India is a comparatively modern institution. In former times, no doubt, considerable areas were scrupulously protected in many parts of the country ; but, wherever this was the case, the forests were kept as game-preserves for the pleasure of princes and great nobles. The idea of conserving forests in order to maintain an uninterrupted supply of forest-produce useful and even necessary for the people,—the idea of maintaining a proportion of the country under forests on account of the indirect benefits conferred on the Empire at large by the very existence of forests,—was never thought of by former governments. Even during the earlier times of British sway, the economic value of forests was not recognised, and they were considered more in the light of impediments than otherwise to the increase of cultivation, and consequently to the general prosperity of the empire. This period, however, has passed away ; and the necessity for the maintenance and conservative treatment of forests, as a mainstay of agriculture, is now almost universally recognised, while Forest Conservancy is regarded as a duty of the State.

India is not, like Europe, a forest-growing country throughout; *its position in a tropical and subtropical climate prevents this, and* areas which, with a lesser evaporation, such as takes place in temperate and cold zones, would be clad with dense forest growth, are here arid and may even be desert. Thanks, however, to the barrier which, in the form of the Himalaya, separates the north of India from the rest of the Asian continent, and in consequence of the

pronounced peninsular formation of the Empire, the greater part of the country is suitable for the growth of natural forests. India is a country of extremes, and contains, on the one hand, ever-green forests of a luxuriance and density such as the imagination can hardly picture, and, on the other hand, deserts. The distribution and character of the Indian forests is due, in the first instance, to *the more or less plentiful supply of rain, and next to elevation and* the influence of the tides. The distribution of the rains in India within distinct periods of time is as marked and accentuated as anywhere in the tropics, and, thanks again to the formation of the country, the monsoons extend far north of the Tropic of Cancer. There are two monsoons, the more important being the summer or south-west. Within the direct influence of the full force of the monsoon rains, the country is covered with evergreen forests. Where the rainfall gets less copious, these change into deciduous forests, gradually blending, with still decreasing rainfall, into dry forests, and ending in unreproductive deserts.

The evergreen forests created by the influence of the south-west monsoon occupy the west coast of the peninsula, up to the *ridge of the mountain chain separating the moisture-yielding sea* from the rest of the continent. In the same way they are spread over the coast districts of Burma and Chittagong, and along the foot and on the lower slopes of the eastern Himalayas. The ever-green forests, due to the winter or north-east monsoon, occupy the Carnatic.

The deciduous forests, which occupy the larger part of the peninsula and Burma and a *considerable proportion of the* Andamans, are of the greatest importance for the forester, the consumer, and the State. They contain the well known and most valuable species of timber, such as teak, sâl, ironwood, sandalwood, red sanders, and many others: also the padouk (*Pterocarpus indicus*), which is found in considerable quantities and of large dimensions *in the* Andaman Islands. This tree has, of all Indian timbers except teak, probably the most promising immediate future. It yields the best wood for ordnance purposes and carriage-building, and is sure to rival mahogany for cabinet-work. The timber is stronger than teak in every direction, lasts longer, is much handsomer, does not warp in seasoning, and only weighs 15 to 20 ℔ more per cubic foot.

The dry forests are situated in Rajputana and the Panjab, and spread over a large extent of Native States. Towards the north and north-west they become richer and gradually blend into deciduous or alpine forests, whereas they get drier and drier towards the west and southwest and disappear into the deserts on both sides of the lower Indus, where the courses of perennial rivers alone are fringed by a belt of arbori-vegetation.

Alpine forests are found within the Indian Empire along the whole of the Himalaya mountain chain from Assam to Hazara, in the mountains of south Afghanistan and Baluchistan, and on the higher mountain ranges in Burma.

The tidal forests are situated along the greater part of the coast of India and in the deltas of its rivers.

The foregoing are, shortly summarised, the physical capabilities of India as a forest-growing country. There can be little doubt that in pre-Vedic times the greater part of the Empire was covered with dense forests, which were gradually opened out by Kshatriya settlers along fertile valleys and main streams. At that time, and long after, the country was probably more fruitful and the climate less fierce than now, at least if any trust can be placed in the descriptions of Fa-Hian, the great Chinese traveller who visited India in the fourth century, and who described the climate as neither hot nor cold. The destruction of the forests on a larger scale was left to the invaders from the north—nomadic tribes who had been accustomed to roam from pasture to pasture, and who fired alike hills and plains, and destroyed the forests wherever they went. The sway of these invaders extended over upwards of 750 years ; and when, after the battle of Plassey, the foundation of the present Indian Empire was laid, and province after province was conquered, the forest areas had already, over considerable portions of the country, been reduced below the minimum necessary for its well-being, though other portions of the vast Empire were still covered with almost virgin forest.

British rule, instead of putting an immediate stop to further devastation, gave in the beginning a new impetus to destruction. As already stated, the watchword of the day was to increase the area of cultivation at the cost of the still existing forests, and this policy was carried on for years without any enquiry into the merits of each case. Naturally, incalculable harm was done by such inconsiderate destruction of forests, especially in the more populated districts where the demand for new land was greatest, and where the forests were often already of less extent than the state of the country demanded. Large areas, through not immediately destroyed, were alienated by settlements and grants, and were thereby withdrawn from further active interference on the part of Government. Security to life and property enabled the peasants and herdsmen to graze their cattle far from their homes and unprotected, and at the same time cattle increased in value. Herds naturally multiplied, and additional grazing areas being required were cleared by fire, thereby opening the way to future famines and distress. Railways soon spread over the country, and forest growth disappeared with an incredible rapidity within the reach of their influence, partly on account of the direct demands made on them for construction works—demands which were frequently supplied in a wasteful and reckless manner—partly on account of the increased impetus given to cultivation.

It was only when failures to meet local demands for public works were brought to notice, that the value of the forests was gradually recognised. At first, attempts were made to meet such

local failures by local measures, but the insufficiency of this proceeding was rapidly brought to light, and it came to be understood that a question of such general magnitude and importance could only be efficiently grappled with by a special organisation. It was thus that the Forest Department came into existence.

As a matter of course, it rested with the Government to show the lead, and the first step in the new direction was naturally to ascertain the extent of the forest property still remaining in the possession of the State, and in what measure such property was burdened by rights in favour of the peasantry. The Oriental Governments, from which the British Government inherited its forest property, never recognised the accrual of any prescriptive right; but, on the other hand, anybody was accustomed, without let or hindrance, to get what he wanted from the forest, to graze his cattle where he liked, and to clear jungle-growth for cultivation wherever he listed. This state of things, it is self-evident, did not permit of systematic forest management, and it became clear that a Forest Law and a Forest Settlement were urgently required. It was necessary that the Forest Settlement should define (*a*) the forests in which the ownership of the State was still absolute; (*b*) forests which were the property of the State, but which were burdened with legal rights, prescriptive or granted; and (*c*) forests, the property of individuals or communities, in which the State had rights over all or certain kinds of growing trees. After several local Rules and Acts had been introduced and had been in force for a longer or shorter time, the first Indian Forest Act was passed in 1865. This was, however, found wanting in many important respects, and was replaced by the Act of 1878. Even in this new Act, however, faults were at once recognised, and separate Acts were passed for Burma and Madras in 1881 and 1882 repectively. All three Acts provide for the formation of Government reserves and the settlement of rights within them; also for the constitution of village forests; and they contain forest police rules necessary for the protection of Government forests and forest-produce. The Indian Forest Act contains in addition provisions for the creation of protected forests. All three Acts provide for the control of Government over forests not belonging to the State, if such control appears necessary for the public weal, or if the treatment which such forests have received from their owners injuriously affects the public welfare or safety. More recently, special Forest Laws for the newly-annexed province of Upper Burma and for Assam and Baluchistan have been passed by the Indian Legislature, and these contain several distinct improvements on the older Acts.

In the Central Provinces and Bengal, forest reservation had made rapid progress under the wise guidance of Sir Richard Temple, and large areas could at once be declared State Forests under the Act of 1878. The rapid strides which forest reservation has made in Bombay are due to the wisdom and foresight of the same eminent statesman, other provinces are following the same line

with more less vigour, as may be gathered from the following table for 1891-92 :—

PROVINCES.	FOREST AREA, IN SQUARE MILES.				Proportion of Forests to whole area of Province	REMARKS.
	Reserved.	Protected	Unclassed.	Total		
					Per cent	
Bengal	5,211	2,181	4,534	11,926	8	
N.-W. P. and Oudh ..	(a) 3,769	93	54	3,916	4	(a) Includes 78 square
Punjab	(b) 1,715	481	3,874	6,070	6	miles of *leased* forests.
Central Provinces ..	19,680	..	393	20,073	23	(b) Iucludes 343 square
Burma (Lower) ..	(c) 5,615	..	..	5,615	7	*miles of leased forests.*
Burma (Upper) ..	(d) 1,059	(e)16,461	..	17,520	22	(c) Includes 461 squares
Assam .. .	3,612	912	5,435	9,959	22	miles of *taungya* areas.
Coorg	113	743	..	856	54	(d) Includes 113 squares
Ajmere	139	..	..	139	5	miles of *toungya* areas.
Baluchistan ..	82	..	..	82	..	(e) Exclusive of the area
Andamans	..	..	1,957	1,957	98	of India-rubber forests
Berar	2,231	..	2,175	4,436	25	of which it is not pos-
						sible at present to from
Total Bengal Presidency	43,256	20,871	18,422	82,549	12	an estimate even.
Madras ,,	(f) 7,175	(g) 9,404	1,304	71,883	21	(f) Includes 37 squares
Bombay * ,,	10,17o	4,319	..	14,489	11	miles of *leased* forests.
						(g) Includes 154 squares
GRAND TOTAL ..	60,601	34,594	19,723	114,921	13	miles of *leased* forests.

* These figures are for 1890-91.

The organisation of the Forest Department was gradually developed at the same time under the energetic management of Sir Dietrich Brandis. The Department, of which the superior staff was re-organised in 1891, is divided into an Upper Controlling Staff (including Conservators, Deputy and Assistant Conservators), a Lower Controlling Staff (providing for Extra-Assistant and Extra-Deputy Conservators), a Protective Staff (composed of Rangers, Foresters, and Guards), and an Office Staff. The Upper Controlling Staff numbers at present 183 officers, of whom 63 per cent. have received a scientific training in forestry and were appointed in England by Her Majesty's Secretary of State. Most of these officers were trained in France, some in Germany ; but since 1885, the education of such officers has taken place at the Royal Indian Engineering College, near Windsor. The forest range is the unit of the present organisation, and the men intended for such charges, as well as those intended for employment in Native States or by wealthy native land-owners, are trained in the Imperial Forest School at Dehra Dun in the North-Western Provinces. Since the establishment of the School in 1878, 166 Rangers have been thus trained. The organisation of the Controlling Staff has been, as pointed out above, completed ; that of the Executive Staff, which must ultimately form the mainstay of forest adminstration in India, is now under the consideration of Government, and considerable additions to the existing numbers of Rangers, Foresters, and Guards will probably be made in almost every province.

The protection of the forests in which, previously to the creation of the Forest Department, no restrictions of any kind existed, was, as may be supposed, a matter of the greatest difficulty. Boundaries were defind where no boundaries previously existed, or at least boundaries which had never formed a restriction had, under the Forest Law, to be respected. Previously, anybody might go into the forest, cut down in a most valuable portion all young trees over any extent of forest he wished, kill the mature ones and make a bonfire of the whole, sow in the ashes, reap a crop, and similarly destroy another area next year. A man wanting covering leaves for cigarettes might cut down a tree without let or hindrance; a cattle owner requiring more extensive pastures, might fire and re-fire the forest, till it became sufficiently open to yield a dense grass crop; cattle and even goats might graze and browse in the midst of forest reproduction. All this had to be stopped.

As regards general protection, the laws, being new, had to be worked leniently. This has been done, and the progress reported from time to time is satisfactory. Where forests suffer, especially under excessive grazing, they do so more from rights granted and privileges permitted during the time of settlement than from subsequent breaches of forest rules. The greatest benefit conferred lies in the stopping of the above-described method of cultivation, locally known as *kumri*, *jhum* or *taungya*, in the Government forests of almost all provinces. This step affords, in the Central Provinces alone, protection to at least 5,000 square miles, which otherwise would have been rendered bare once in every fifteen to twenty years. In the protection of forests from fire there is still much to be learned and done, and in almost every province it is necessary to depend more on fire-tracing and fire-watching than on the help given by legislation. The law, while sufficiently stringent for reserve and even for protected forests, is quite inadequate to protect them from fires spreading into them from adjacent private forests and grazing lands and from open forests belonging to the Government, though the Burma Government has recently shown that most valuable results may be attained by insisting that the conditions of the law in regard to prairie fires shall be respected outside the forest areas. In all these classes of areas, fires intentionally lighted still often occur, and spread wherever the wind may carry them. This, apart from the mere protection of the Government forests, is probably one of the most important questions connected with forestry, and consequently with agriculture, in India. These annual fires are the main reason of the barren condition of most of the Indian hill ranges, and are closely connnected with distress and famine. Many prejudices will have to be overcome in order to check this evil, and it will take the full power of Government to do so.

In the meantime practical steps have been taken to prevent the spread of external fires into the more valuable Government forests. During 1891-92, 24,000 square miles were thus protected

from fire, at a total cost of Rs. 2,42,000, and the following table gives a *résumé* of the work done:—

Results of fire-protection in the forest circles administered by the Forest Department.

CIRCLES.	TOTAL NUMBER OF ACRES.			Total cost.	COST IN PIES PER ACRE.	
	Attempted.	Failed.	Protected.		Attempted.	Protected.
Madras Presidency ..	2,941,676	170,433	2,771,243	45,318	2·9	3·1
Bombay * „ ..	6,620,160	1,233,289	5,386,880	16,571	0·5	0·6
Bengal	1,264,115	256,420	1,007,695	12,492	1·9	2·4
North-Western Provinces and Oudh	1,741,038	61,797	1,679,241	48,714	5·4	5·6
Punjab	189,910	23,594	166,322	2,106	2·1	2·4
Central Provinces ..	2,476,395	135,008	2,341,387	52,191	4·0	4·3
Upper Burma	682,320	553,770	128,550	805	0·2	1·2
Lower „	320,867	3,338	317,529	31,844	18·8	18·10
Assam	730,556	88,556	642,000	19,483	5·1	5·8
Coorg	130,715	16,274	114,441	5,290	7·8	8 9
Ajmere	89,228	..	89,228	45	0·1	0·1
Berar	727,943	7,753	720,199	7,780	2·0	3·1
TOTAL	17,914,929	2,550,223	15,364,706	2,42,139	2·6	3·0

* These figures are for 1890-91.

By fire-protection, the regulation of grazing, and the general protection of the forests, ample reproduction is ensured as a rule, after a shorter or longer period, in the more valuable forests of India, though, in some of the drier regions, areas thoroughly desolated and with unfavourable soil will resist improvment for the time being.

Most Indian forests are of a mixed character, containing only one or a few valuable species which repay the cost of working. Moreover, all age-classes are generally represented on the same area, and this necessitates working by selection (Fr. *jardinage).* It is self-evident that these facts make the problem of forestry—to secure a continuous yield proportionate to the stock on the ground without causing the deterioration of the forests—extremely difficult. In previous times the work was carried on haphazard, or based sometimes only on an exceedingly rough valuation of the growing stock. As a rule, however, the demand and requirements for forest-produce were the only considerations by which the exploitation was governed, and no attention was paid to the potential capabilities of the forests. Of late, however, more pretentious working-plans have been made, and several provinces have

organised a division or staff for this work only. The working-plans made in the provinces under the Government of India are scrutinised and audited by the Inspector-General of Forests before they are passed by the Local Governments. The working-plans take special notice of all measures necessary to encourage and, what is infinitely more difficult in a mixed forest, to guide natural tree reproduction ; and they prescribe any artificial means—such as girdling of inferior trees, dibbling in of seed, etc.—that are required to assist natural regeneration of the species or admixture desired. The forests controlled by the Department are, however, by far too extensive, and markets at high rate are not at present sufficiently general and secure to permit of the extensive use of the more elaborate methods of European sylviculture. In special connection with the preparation of working-plans, the Forest Survey Branch of the Imperial Survey Department has been formed.

The exploitation of timber, at least of the more valuable timber, from Government forests, is carried out partly through the direct agency of the Department and partly by contractors. Of minor forest-produce, the most important at present are grass, hirda fruit (*Terminalia Chebula*) bamboos, cutch, cardamoms, catechu, and lac ; but there are many others of lesser value.

The estimated yield in timber and fuel, in cubic feet of all Government forests was as follows during 1891-92:—

	Timber.	Fuel.	Total.
	c. ft.	c. ft.	c. ft.
Bengal	7,260,725	21,495,028	28,755,753
N.-W. P. and Oudh.	4,204,645	7,673,285	11,877,930
Punjab	2,381,030	28,968,083	31,349,113
Central Provinces	1,756,433	6,760,265	8,516,698
Burma (Upper)	7,352,485	1,506,598	8,859,083
Burma (Lower)	11,773,094	2,802,034	14,575,128
Assam	2,246,290	2,608,988	4,855,278
Coorg	398,844	196,000	594,844
Ajmere	7,300	191,098	198,400
Baluchistan	6,122	152,588	158,710
Andamans	415,874	1,150,636	1,566,510
Berar	621,454	1,558,341	2,179,795
Madras	3,086,937	13,987,173	17,074,110
Bombay	6,842,524	26,422,016	33,264,540
TOTAL. ...	48,363,759	115,472,133	168,825,892

The following table exhibits information in respect of the sea-borne exports of forest-produce from India to foreign countries in 1891-92 :—

ARTICLES.	Quantity in tons of 20cwt. in the case of Teak, cubic tons	VALUATION AT PORT OF SHIPMENT	
		Total.	Per ton.
		Rs.	Rs.
Caoutchouc ... . Tons	467	11,72,370	2,510
Shell-lac ... ... ,,	5,514	60,67,924	1,100
Lac-dye ... ... ,,	2	2,500	1,250
Sandal, Ebony and other ornamental woods	(Information not available.)	8,41,938	...
Cutch and Gambier ... ... Tons	9,853	31,72,992	322
Myrabolams ... ... ,,	39,540	39,36,902	100
Teak ... ... ,,	48,190	47,48,517	99
Cardamoms ... ... ,,	124	3,18,957	2,572
Total in 1891-92 ...	...	2,02,62,100	...
,, 1890-91 ...	.	1,77,40,556	...
Increase in 1891-92 ...	...	25,21,544	...

Arrangements have recently been made for the dissemination of information on these and other important Indian forest-products among the commercial community and other persons in Europe interested in the trade. Monographs on the more important products appear from time to time in the pages of the *Indian Forester,* and are subsequently republished in the series of penny handbooks issued by the Imperial Institute in London.

The financial results of Forest Administration in India have been as follows :—

QUINQUENNIAL PERIODS.	Revenue.	Expenditure.	Surplus.
	Rs.	Rs.	Rs.
1864-65 to 1868-69 (annual average)	37,38,189	23,81,732	13,56,457
1869-70 to 1873-74 Ditto ...	56,25,693	39,89,632	16,36,061
1874-75 to 1878-79 Ditto ..	66,55,913	45,76,372	20,79,541
1879-80 to 1883-84 Ditto ...	87,84,514	56,07,652	31,76,862
1884-85 to 1888-89 Ditto ...	1,16,68,148	74,26,956	42,41,192
1889-90	1,53,03,572	80,12,518	72,91,054
1890-91	1,49,67,135	80,63,125	69,04,010
1891-92	1,53,63,706	86,23,852	67,39,854

(Extract from the Hand-book of exhibits of the Indian Forest Department, at the Chicago Exhibition, 1893.)

Chakla Drogmula.

Perhaps the most picturesque part of the Kashmir plain is the valley of the Lolab or Pohru River; the former name appretaining only to the upper reaches of the river. Immediately below the outlet of the Lolab valley, the tract of land on this river is called the Drogmula Chakla ; the principal villages on the left bank being Drogmula itself and Kandi, a few miles lower down, some three miles in a direct line from the river bank. Of all the pretty places in this beautiful country,probably none surpass and few equal those to found at and around Kandi. The country between the village and the river is gently undulating like many parts of Devonshire ; here, a stretch of verdant grass, there a ploughed field ; while interspersed are small ravines containing thickets of fruit trees of all kinds such as pear, plum, apple, quince, cherry, hawthorn, etc., all of which are now (May) in full bloom presenting a glorious spectacle of hundreds of trees laden with snowy blossoms. When the fruit is ripe, the bears come from the range above, and, in consequence, all these trees are protected and the place is called a state shikargah. This plain, so to call it, ends almost abruptly at the foot of the range which divides the Lolab from this valley. The elevation of Kandi is somewhere near 5,500 feet, while the range rises to more than 3,000 feet above this. It takes a wide circular sweep from Drogmula, enclosing the Kandi lands, then a point juts out into the plain ; again another backward sweep round the village to Túrús till it finally abuts on the river some 3 miles further down at a place called Natanusa. In a recess of the first or Kandi curve, at the very foot of the range, is a most beautiful nook in which is a famous spring known as Ladhu Gunga and here dwell a number of Ladhus ;·here also

come many others from afar to drink the sacred water. The pool itself is quite a small one, having stone walls on all four sides. Ferns, grasses and flowers grow in the interstices of the stones, while all around are pretty bushes of Parrotia, hawthorn, wild rose, yellow jessamine, etc., and a little above, on a gently sloping bank, stands a magnificent deodar, towering up to perhaps 150 feet above the ground; between the bushes is a lovely green sward covered with wild strawberry and other flowers, the whole forming a peaceful scene of rural beauty that could hardly be surpassed in any country in the world. At about half a mile from this spring, is another of smaller size, known as Narin Nag; this also is protected by a stone wall on all sides, the stones carefully cut and laid and of large size. This spring is surrounded by huge poplars, a very fine chinar, and a number of fruit trees, among which is a copse of white-heart cherry trees, perhaps fifty in number; in Kashmir these are called *gilás* and are much prized, the fruit is of excellent flavour but hardly as large as the English cherry. It is my good fortune to be now encamped close to the Ladhu Ganga while engaged in the work of demarcating the forests in this Chakla. I usually start early in the morning and work my way along the edge of the forest, putting up marks which are replaced during the day by posts, supported by dry stone pillars. The work goes on till breakfast time, when usually my wife and daughter bring breakfast to some point agreed on, where I join them; we generally choose a spring or the bank of a pretty rivulet and many a pleasant hour have we spent thus. The little one is allowed, to her great delight, to paddle in the stream as she calls it; and many are the curious things she finds in the water. A few leeches, same beasts exactly like shrimps of small size, curious cricket-like insects and others come waddling out from under the stones as she turns them over. After an hour or so, we return to the tents for the day, till the heat is past, for it can be very warm on a bright day. In the afternoon, if we do not play Badminton, for which we carry the implements with us, we saunter out into the forest and hunt for morels, known here as "guchi" or "kanguchi;" these are very plentiful just now and we eat them in all sorts of ways, as an adjunct to meat and also in the shape of "toasts" and very good they are; there are two kinds, one of which has the head attached to the stalk and the other in which it is free, as in a mushroom, and shaped like a closed umbrella. One day I found *Ophioglossum vulgatum* and on asking a Kashmiri if he had any name for it, he at once said *chouchru*, adding that it was excellent eating boiled like a *sag*. Now, I always try new things that are found in the wilds, for they often stand one in good stead; and this puts me in mind of an incident that once occurred to me. I was at a Mess in the hills and happened to observe that the young fronds of the *Diplazium polypodioides* (called *Kisror* in Chamba) were very good eating and much resembled spinach; at this several of the yonng fellows

snorted and one said he never partook of native vegetables, a true British conservative he! Their Colonel, however, like myself, was in the habit of trying new things, so he and I concocted a mild sell for the youngsters. I left the place next day and shortly after happened to visit a forest near, where I was able to get a good basketful of the young curled heads of the fern; I sent a man off post haste to the Colonel and awaited results. The sell was a complete one, the fern was prepared like spinach and all the young fellows ate it with gusto, some noticing nothing, others observing they had no idea spinach was to be had so early; so much for never tasting native vegetables. Some of the *chouchru* were cooked for us by the servant of one of my officers and we found them very good eating, so we turned to collecting ourselves. At first we could find few leaves, but now they are very abundant; our ordinary haul is 1½ lbs. in an hour; it grows largest in the shade of bushes or tufts of grass and some specimens were 13 inches long, without the roots which are very deep down. I have found this fern in Chamba, but only a few plants here and there, but in this place they are in thousands everywhere. One day, while gathering them, I suddenly came upon what I have been seeking for years, a *Botrychium*, which I once found in Chamba long ago, at least I think it is the same; leaves very much cut and the fertile spike springing from the base of the sterile portion, neither above nor below. I found two specimens about a foot high, of course quite unripe, spike well developed, and suppose it is *B. virginianum.* As yet all ferns are too soft and unripe to begin collecting, but they are at their most beautiful stage, especially *Adiantum venustum* which is far prettier now in its delicate yellow green stage, than later on when it has ripened into a dark sombre shade. The Ladhus are very friendly; they are Kashmiri pundits and very quiet and unassuming, we often exchange a greeting with the head man, a smiling genial old gentleman. He one day asked if he might send some cooked vegetables and I assented and shortly afterwards an assortment appeared, in six little brass cups, mostly cooked, (not the cups,) but one cup contained a very tasty little condiment of uncooked green stuff pounded up with milk; since then he often sends up a supply. They possess many cows and send us delicious milk and we, in turn, give them cream butter which they much appreciate; they have a garden in which they grow herbs of sorts and I intend giving them some good seeds. They cultivate some land around the spring, but, as they live by charity and have to feed many travellers, the land revenue is paid for them by subscription among the neighbouring lambardars. This is a great place for walking sticks, the barberry (*B. aristata*, I think) is common, and many fine sticks with beautifully streaked bark are to be had, but a straight one, with a really good head, is only to be got now and then and is a great prize. Apparently this is called *chitra* in the Punjab, which is the name

of the *Staphylea Emodi*, which also has a striped bark and probably from this fact, the natives mistake one for the other. The Kashmiri name for the barberry is something like *Lukutsing* but it is hardly possible to render their words in English as the pronunciation is so curious, *ch* being sounded like *s*.—*Cotoneaster* (*liun* or *lin*) is plentiful here but good straight sticks with root heads are few and far between. *Parrotia Jacquemontii* is one of the commonest bushes of the undergrowth, it was in flower early in May. Just now there is a plague of small caterpillars which are a nuisance in the jungle, as the hairs produce a stinging eruption like nettle rash, if they come in contact with the skin. The small red plum called *aleucha* is already of a good size, so it is probable the fruit season will be an early one. The voice of the cuckoo is heard in the land, indeed he calls all day long, the golden oriole has appeared and the long tailed mag-pie is common; there are crows, but he is a very mild bird compared with his impudent brother of the plains; this is a smaller type with a grey head, and his cry is a feeble sort of chirp not the aggravating caw of the other, nor is he in the least a forward bird in his habits.

Near Ladhu Ganga, the spurs of the range slope downwards very sharply into the valley, but near Kandi village the descent, though steep in the upper levels, is a very gentle one lower down, from the edge of the forest through the fields to the flat land below; a horse can be ridden up several of the spurs for a good distance and from here there is a most magnificent view. Let me try to describe it, through word pictures are hardly in my line. The background is formed by the great Punjal Range on the left, and directly in front, the Kazinag peak 14,400 ft., stands out clear against the sky; the summits covered with glittering snow and the base dark with pine forest; nearer, lie range after range of dark blue hills, the beautiful grey mist bathing their feet; nearer still lies the peaceful valley, carpeted with verdant grass and dotted with trees of all the delicate shades of green, while from among them, peep the picturesque farmsteads of the dirty Kashmiri. To the left in the middle distance, several spurs trend gradually down into the valley, their hue the dark and sombre one of the deodar-clad hill; the outline sharply defined against the more distant mountains, while on the right, where the plain is more open, are seen the dark clayey fields, the "bit of colour" dear to the eye of the artist. In the immediate foreground, a little to the right, stands a clump of deodars the branches clear and distinct in every detail, against the setting sun which bathes the scene in golden splendour. "Where every prospect pleases and only man is vile."

J. C. McD.

(*To be continued.*)

The Forest of Ne-Ha-Sa-NePark in Northern New York.

From a report recently prepared by Mr. Gifford Pinchot, on the condition of a large forest estate in the Adirondacks, we are permitted by the author to print the following extracts, which are of general public interest, as Mr. Pinchot's conclusions and suggestions with regard to the management of the property are applicable to similar forests in many of the Northern States.

"Except for local variations and the greater proportion of the soft timbers in the western and northern part", Mr. Pinchot writes, "forest over the whole park is approximately the same. 'The high ground is covered by a magnificent growth of hard-wood 'timbers, thinly interspersed with spruce. Beech is here the most 'common tree, with birch and maple closely second. The swamps 'and low grounds are chiefly occupied by balsam, tamarack, 'hemlock and white pine. To these, which have been mentioned 'in the order of frequency, are to be added in the same order, 'cherry, poplar, cedar and ash. Spruce and pine are at present 'the most valuable timbers. It seems likely that in future birch 'will be the most important tree. The silvicultural value of the 'soil has been reached by the accumulation of mould from the waste 'of many generations of forest-trees. The ground itself is rocky 'and not rich, and its sustained vigor depends entirely upon the 'preservation of the humus or duff, with which it is covered almost 'everywhere, sometimes to the depth of six feet. Humus dis-'appears gradually upon free exposure to light and air, and may be 'entirely consumed by forest-fires. Hence fire and reckless 'cutting are especially destructive to the Adirondack forests, 'entirely apart from the important loss which they occasion in 'standing timber and the growth it would have made during the 'years in which the burnt area is slowly reclothing itself with 'forest."

Want of space compels us to pass over the description of many of the trees found in the Adirondack forest. Of the white pine, he says that "it grows on the West and South-West slopes of the ridges and on the borders of swamps in mixture with spruce and balsam. It would be exceedingly advisable, how ever, to defer this removal at least in part, until the reason can be discovered why the enormous number of cones produced by this tree do not result in a plentiful young growth. It is possible that the conditions favourable to the germination

and growth of the pine seed may by found to be producible at very little cost, so that it may be possible to assure a large proportion of this valuable timber in the next crop."

In discussing the age of the trees found in this forest, Mr. Pinchot points to the fact that "young trees are almost always 'seriously retarded in their growth by the heavy cover of the 'older specimens. For this reason, the rings of annual growth 'formed during early life, are much closer together than the later 'ones. In endeavouring to count the rings of stumps standing on 'the right-of-way near Lake Lilla, I was often unable to separate 'those of the first fifty or one hundred years, even with a glass. 'I found no maple or birch whose inner rings could be counted, 'and but one beech. This tree was twenty-eight inches in diameter 'at four feet from the ground, and somewhat over two hundred 'years old. A hemlock of seventeen inches diameter on the stump 'was two hundred and ninety two years old. Spruce stumps, on 'which all the rings were far enough apart to be counted, were 'also exceptional. One butt log, with a diameter of seventeen 'inches, was two hundred and eighteen years old. This tree had 'evidently been stunted by the shade of older hard woods. It is 'remarkable that the finest spruce, that on the hard-wood ridges, 'must have passed through this period of repression before making 'its principal growth. By cutting away the merchantable hard '*woods, which are suppressing the young spruces over a large* 'portion of the park, their rate of growth may be enormously 'increased. For example, two young spruces, eight inches in 'diameter, which had grown among others of the same age, and 'therefore, with a comparatively abundant supply of light and 'air, were but fifty-two and sixty years old, although almost twice 'the diameter of another tree one hundred and twenty one years 'old.

"The power of natural regeneration of all the trees which 'I have mentioned, with the single important exception of white 'pine, seems to be amply sufficient for all the purposes of forest-'management. The presence of this reproductive power is of the 'greatest importance. It puts aside at once the difficulty and 'expense of planting and insures a steady improvement in the 'condition and value of the forest.

"The vigorous and abundant young growth makes it possible 'to remove mature trees without injury to the forest, and under 'proper handling will insure the continuance of its productive 'power. The constant character of the forest, even in its changes, 'lends itself easily to the needs of forestry, while the presence 'everywhere of mature trees over the young growth makes it 'possible to cut and yet increase the annual growth of wood from 'year to year. This steady increase in the value of the forest under 'forest management is one of the strongest reasons for its intro-'duction. Forest management will add constantly to the propor-'tion of valuable timbers in the forest, by judicious cutting

'without a corresponding abatement in the amount of lumber, 'produced. In other words, for a few years, the forest will yield 'slightly more under ordinary lumbering than it will under forest 'management, because, in the latter case, greater care is used, and 'many trees which would otherwise fall at once must be allowed 'to stand. After that time the revenue from forestmanagement 'will surpass that from lumbering, and will go on increasing indefi- 'nitely, while the returns from lumbering methods will as steadily 'diminish. The profits will certainly pass their lowest point during 'the first twenty years, and probably during the first ten. There- 'after, they will rise with the rise in prices and the growing 'productive capacity of the forest. Timber-land as productive as 'this, as safe from fire, and as accessible to the centres of consump- 'tion by rail and water, is, in my judgment, one of the best of 'long investments".

Mr. Pinchot recommends that this forest should be carefully examined and mapped with a working plan made "with the 'supposition that it will be best to cut over the same ground a 'second time at an interval of from twenty five to forty years." 'Then he would "divide the forests into as many parts as there 'were years in the period decided on, and assign the land most in 'need of cutting to the first year, the second to the second year, 'and so on ; but in such a way as to make the annual production 'of timber as uniform as possible."

The forest managed in this way is expected "to yield a 'steady annual return, which ought to constitute a fair rate of 'interest on the investment," and "to increase the value of the 'forest by favoring the better kinds of trees, so that the market 'value of the land, as well as the return from the lumber, would 'increase steadily from year to year".

In conclusion, Mr. Pinchot discusses Lumbering *versus* Forestry as follows :—"The statement is often made that it is possi- 'ble to lumber the same land a second and then a third time at 'intervals of fifteen or twenty years, and get as good a cut from 'it as at first. In exceptional cases this is true. The probabilities 'are, however, that the second and third cuts were as good as the 'first in a pecuniary way, and not otherwise, since during the years 'which intervened, the diameter of merchantable trees has steadily 'diminished, while the price of lumber has increased. Forestry 'provides not merely for sustaining the proportion of the more 'valuable woods, but for increasing it.

The ordinary methods of lumbering are exceedingly careless of the life of all the young growth which may happen to stand about the old trees. Such carelessness is not only destructive of the future value of the forest, but also increases the danger of fire by the presence of a quantity of dry saplings which forests management would have allowed to grow. Young green trees are the greatest protection a forest can have against the spread of

fire. Hence forest-management tends distinctly to keep fire out, as compared with the methods of ordinary lumbering.

"Lumbering yields a slightly larger revenue than forest-'management, but in the end falls far behind it. It increases 'the danger from fire, tends to deprive the forest of its more 'valuable timber and lowers its capital value. Forest-management 'does none of these things".—(*Garden and Forest.*)

Date Planting in Australia.

Information lately received shows that the experiments in tree-planting, in the interior of the colony undertaken by the South Australian Government, have proved successful. A special feature is the splendid condition of the date palm; these trees are already bearing fruit. Some of them were planted by Mr. Ednie Brown, late Director-General of Forests, eight years ago. Such a result is specially satisfactory when it is remembered that it takes longer than the period named for such trees to bear fruit in Egypt and India. The trees were planted at a place called Hergott Springs, situated upon the overland railway line, and were subject to the overflow of a salt-water bore. The fact that these trees will grow in a brackish country is looked upon as important in this country, where so much land is of this nature. Something like 10,000 date seeds have been planted in South Australia by supplying exploring parties with the fruit. It is the intention of the Forest Department of this colony to experiment by sowing the seeds at the different bores which have been carried out by the Water Conservation Department. The experience of South Australia proves that trees will flourish when sown artificially. In some experiments which were *carried on at Mount Herbert* it has been proved that, upon poor soil, some 350 trees per acre had been reared. With proper application and the selection of suitable trees it would, it is stated, be quite within the bounds of possibility to reforest country which is now quite barren. The experiments made last year upon the commonage at Wilcannia are reported as having succeeded satisfactorily. Notwithstanding that the trees were planted late in the season, and that no rain fell for five months, a very fair percentage of them survived. The planting is to be continued, and something like 10,000 or 15,000 trees will be put out as opportunity offers. Experiments in the same way are also likely to be made at Bourke, Wentworth, and Broken Hill. There are in the state nurseries here some 200,000 trees available for distribution, and the planting of them out can be proceeded with from the present time up to August. *(Pioneer.)*

Planting of the Sandhills on the Sea-coast of Norfolk.

Holkham Sandhills, the property of the Right Honourable the Earl of Leicester, K. G., were rabbit warrens until the year 1850. They extend about three and a half miles along the Norfolk coast, from five to twenty five chains wide, bounded by the German Ocean on the north, and on the south by rich pasture land reclaimed from the sea, dating as far back af 1660, when the first enclosure was made. These hills are held together by a plant called *Psamma arenaria*, which has a strong creeping perennial root, with many tubers at the joints about the size of a pea. It is planted and encouraged on the Norfolk coast to aid in fixing the sand against the action of the wind and tides, which it does in a remarkable manner. The "marrum," as it is locally called, or bent-grass, is considered of so such importance that there are severe laws to prohibit its being destroyed. Mats are made of it, and it is also used as thatch.

Elymus arenarius, the sea lyme-grass, a strong, rough, glaucous plant, common on sandy shores, is also frequent here, and answers the same purpose in fixing the sand as the "marrum." In analysing the soluble matter afforded by this grass, Sir H. Davy found it to contain more than one-third of its weight in sugar. It is not, however, eaten by any of our domestic animals.

About 1850, I sowed several kinds of pine seeds on the sandhills, putting some of the seeds in small pellets of clay and inserting them in the sand, and in vaious other ways. I did this for two or three years in succession, but it ended in failure. I then planted a few plants of well established *Pinus austriaca*, *P. Laricio* and Scots fir, and had them thoroughly protected from rabbits, never thinking they would do much good in the pure sand, but I was agreeably surprised at the end of the first season. The plants all lived and made one or two inches of young wood, and seemed healthy; the second year they did better, when I drew the Earl of Leicester's attention to the matter, and he was so satisfied with the growth of the trees that were planted that he at once set about destroying the rabbits, and planted a small portion of the hills every year till the whole was completed.

The east end of the hills, nearly two miles in length, which was only partly planted previous to 1875, is a very thrifty young plantation, not only being a shelter for the adjoining pasture, but forming a grand and peculiar feature in the landscape, and the trees doing much better than the most sanguine could expect.

Mr. Munro, the Earl of Leicester's intelligent forester, writes to me about this division of the hills, and says :—" When he came to Holkham in 1877, the trees in many cases were very good, but the tops of the *Pinus Laricio* were very much cut with the northerly winds and blowing sands. He at once commenced planting the tops of the hills, principally with *P. austriaca* and a sprinkling

of *P. austriaca*. When these got hold and began to get up, the *Laricio*, which were cut by wind, began to improve, and by 1882 a very decided improvement was visible. Since then, seeing the progress the plantations made, he went on extending them, until the area planted is now double what it was in 1882."

The proportions in which the plants are used are :—

Pinus Laricio,	50	per cent.	planted 8 yds. apart.
„ *austriaca*,	25	„	5 to 7 yds. apart.
„ *sylvestris*,	20	„	„ „ „
„ *maritima*,	5	„	„ „ „

Let it be distinctly understood that the plantations are ornamental, and are not planted for profit, hence the distance between the trees, giving plenty of room for developing their laterals. The *austriaca* and *maritima*, being on the higher and more exposed situations, and fully exposed to every storm from the German Ocean, are planted 5 to 7 yards apart, as they cannot possibly make the same growth as the *Laricio*, which are more sheltered. The *Laricio* are now in many cases 30 to 35 ft. high, their lateral branches covering an area equal to a circle of 8 yards in diameter, and are full of health. The Scots fir and *austriaca* are making a proportionate growth. When at Holkham last spring, Mr. Munro had just finished planting a large area of the West Sandhills, and, notwithstanding the previous cold and unpropitious winter and spring, I only saw a single dead plant, which reflects great credit on Mr. Munro's management.

Altogether this is a most interesting item in forestry, but I am not aware of any notice of this or similar undertakings having been mentioned in any British work on forestry. Professor Wagner, however, writing to the Prussian Minister of Agriculture, and recommending to him the cultivation of *Lathyrus sylvestris*, a strong perennial-rooted species of the Everlasting Pea tribe, for the immense area of barren sandhills along the coast of Northern Germany, points out that it would form a far superior means for bringing these vast wastes under profitable and permanent cultivation than the planting of pine and fir trees. Little faith was, however, put in that statement, until its correctness had been visibly proved on a large scale by Imperial Privy Councillor of Commerce, Otto Kuchnemann, of Stettin, Pomerania, Germany, who had for many years, and at heavy expense, endeavoured to grow on his sandhills pine and fir trees, but had failed to succeed, the young trees being partly smothered or uprooted by the evershifting sand, and those surviving were vegetating so weakly that the attempt was tantamount to failure. Now a flock of sheep is kept on the *Lathyrus* fodder grown on the identical sandhills where six years ago not a blade of grass could be seen— —ARCHIBALD GORRIE, *in the Transactions of the Royal Scottish Arboricultural Society.—(Timber Trades Journal.)*

THE

INDIAN FORESTER.

Vol. XIX.] **August, 1893.** **[No. 8.**

A tour in Jaunsar.

BODYAR FOREST. April 21st to 26th.

This forest, which has an area of 1,463 acres, has been protected from fire since 1872. Owing to its proximity to the villages below Chakrata, heavy demands were made on it before it came into the hands of the Forest Department, and in 1869, when Chakrata was built, a good deal of timber was taken out. The consequence is that the large deodar trees are far apart and are quite unfit for sleepers, being covered with branches; but there is a young forest of poles coming on which will in course of time be exceedingly valuable.

The first sowings in Bodyar were made in 1872, seed being sown in drills close to the bungalow, and superfluous plants put out into blanks. The present average height of these plants is 18 feet (88 trees measured).

In 1875, nurseries were formed in various sheltered places. We visited one of these situated below the bungalow to the west of the path leading down the spur. Several deodar plants were left in this nursery and they now form a complete canopy; the lower branches have died and were pruned off in 1892 by the students, and the height of the dominant trees is now over 30 feet.

Measurements taken at different times in this old nursery are as follows:—

April,	1886,	Average height		8 ft. 2 in.
May,	1887,	„ „		11 ft. 5 in.
April,	1888,	„ „	(24 plants)	13 ft. 0 in.
„	1892,	„ „	(27 plants)	21 ft. 0 in.
„	1893,	„ „	(13 plants)	30 ft. 7 in.

This excellent growth is due to the good soil and sheltered position, and to the roots remaining undisturbed.

The plantation formed by plants from this nursery is No. 7 of 1878, situated in compt. 4, to the east of the path. The aspect is south-east, as a rule, and the soil is rocky and shallow. The plants are yellow, and the progress made has been slow. In May, 1887, the height was 3 ft. 8 in ; in April, 1888, the average of 25 plants was 4 ft. 2 in. ; in 1893, the height of 333 plants was 6 ft. 9 in ; the average length of last year's shoot was 6 ins., but it varied from 3 ins. to 15 ins. according to soil, aspect, &c. Blue pine was sown in patches between the deodar some 6 or 7 years ago, and is now growing strongly with more than one plant in each patch; there are however many gaps.

From this plantation we descended to the Bodyar fields, and went up to Bangialani dhar, through compartment 1, and a series of old patch sowings of 1877 and 1878. Generally speaking, blue pine and deodar were sown in patches, and in several of them there are 4 to 5 plants, but there are many blanks, and the crop is nowhere continuous. In favourable aspects, the height of the taller deodar is 15 to 18 ft. and that of the blue pine some four to five feet higher. The following account of these sowings was given in the Journal of 1888 :—

" We inspected various sowings of 1877 and 1878 along the 'path to Bangia Lani ; deodar and blue pine were sown in 'patches, every fourth patch being sown with the latter ; the 'average height of 84 deodar was 4 feet 4½ inches ; the average 'height of 31 blue pine was 6 feet 4 inches ; these were situated 'below the path, and it is believed they were sown in 1877.

'The slopes above the path were sown in December, 1878, and 'here the average height of 88 deodars was 4 feet 7 inches, and 'the average of 29 blue pine, 5 feet 11 inches.

'The aspect where these sowings have succeeded best is north-'west, and the soil deep and good ; on this aspect young deodars 'did not present that yellow appearance which we noticed in the 'plantation of 1878 on the southerly aspect."

The heavy snow of the past winter which drifted over the ridge and was still lying in deep masses at the time of our visit, has done an immense amount of damage to the young plants, smashing them completely in several instances, up-rooting and bending down others. In cases where the plant is broken in two, it would be advisable to lop of the broken part just above a verticel, and trust to one of the side branches forming a leader. Plants that are merely bent down might be supported from underneath by a forked stick.

In 1892, we found the average height of 82 deodar to be 10 ft., of 23 spruce fir (also sown there) 6 ft. 8 in, ; and that of 30 blue pine 12 ft. In the lower portion below the path, the deodar shewed a height of 10 ft. 8 in. ; and blue pine 16 ft.

We examined the matted state of the grass in this portion of Bodyar, and the difficulty of natural reproduction by seed under such circumstances was clearly explained. Natural reproduction

of pine and deodar rarely takes place under such conditions, but only when the grass is quite short and the rootlets of the germinating seed can reach the soil ; the best examples of all are recently abandoned fields as at Koti Kanasar. But the preservation of the grass for 20 years has resulted in a fair amount of vegetable mould, and in all patch sowing, or pit planting here, the black soil clinging to the roots of the grass should be well beaten out and mixed with the soil in each case.

The cones of deodar, blue pine, and spruce fir were shown to the students and the different manner in which the seed is dispersed was explained. The two former trees are the best for re-sowing blank slopes.

On the way back, we passed through the thicket of deodar mentioned in the Journal of 1888, as follows :—

"On the road to camp, we examined a large patch of natural 'deodar which has sprung up in some old fields abandoned about '19 or 20 years ago ; the aspect of this slope is north, and the crop 'of deodar is so dense that it is difficult to make one's way through 'it. This is an absolute proof, if any were needed, that deodar will 'prosper in good soil and on a favourable aspect without any pro-'tection overhead."

Since then several of the fir have been girdled and the lower branches of the deodar pruned. Some of the fir girdled two years ago are still alive, generally the larger ones. For facility of moving about inside this thicket the suppressed trees might be removed, and the lower branches pruned off ; this would facilitate the inspection and study of this interesting young crop ; but it must be remembered that over large areas of an almost pure crop such as this is, the removal of suppressed trees is not advisable, first of all on account of the expense—the produce not being saleable—secondly, they are of great assistance in helping to form clean boles.

On the way back to camp we passed some deodar poles marked for sale to the Sappers and Miners. This is an instance of a true thinning, and the object of such an operation and the manner of carrying it out were explained to the students. The leaf canopy would not be interrupted by this thinning, and yet the dominant trees would have more space given to their crowns to increase laterally. A better example than this could scarcely be found.

April 21st. We inspected plantation No. 1 of 1881. It is situated in Ganwa, Compartment 7 (c) of Working Plan, and was raised from seed sown in December, 1878. Some of the plants in the Bodyar nursery were pricked out into beds with a hard bottom, others were raised in ordinary beds in Ganwa. For some years a difference was noticeable between the growth of these two series of plants, and in 1891, it was found that the average height of the plants raised on hard bottoms was about 10 inches more than the ordinary plants. We did not however observe an appreciable difference between the plants and did not take separate measurements.

In 1891, the average height of 320 plants was 4 ft. 2 in.; and in 1893 we found the average height of 152 plants to be 4 ft. 11 in.

The aspect of this plantation is E. N. E. and the slope 35°. The plants out in the open are looking yellow. We measured the the height of 11 plants growing under the shelter of a large blue pine, and found the average to be 6 ft. 9 in., thus shewing the beneficial influence of side shelter. These plants were hoed in August, 1892, and the grass quite cleared round their roots, and it remains to be seen what effect, if any, this operation will have on their growth. This loosening of the soil, immediately before such an exceptionally severe winter has undoubtedly allowed the snow to bend down the plants more than it otherwise would have done; but this of course could not have been foreseen and in ordinary years the operation would have been most useful.

On the *25th April*, we examined plantation No. 8 of 1878. It is situated above the Ganwa path and on the western side of the first large ridge going from the Bungalow (Compartment 4 of Working Plan). 1,131 deodar plants were measured and gave an average height of 9 feet. One plant had an annual shoot of 29 inches. On the whole the progress made has been slow, and the plants are yellow.

Plantation No. 3 of 1879 is situated just below this, between the upper and and lower Ganwa paths :—918 deodar growing on the westerly aspect had an average height of 9 ft. 6 in.; while 62 plants growing on a southern aspect shewed an average height of 6 ft. 6 in. The minimum was 3 ft. and the maximum 30 ft. Lower down blue pine has been sown in patches, and is now 6 or 7 years old with an average height of 4 ft. 6 in. (440 measured).

Near the landslip, 93 deodars gave an average height of 14 ft. 10 in.

Both these plantations were raised from seed of 1875, sown in the Bodyar nurseries; in the upper plantation, the plants were 2 years old when put out in July, and in the lower one, 3 years old.

Strip sowing of Blue pine in Ganwa.

In Compartment 7 (*a*), over an area of 28½ acres, strips running in contour lines were hoed up last year, and all grass roots removed. The strips are 2 ft. and 4 ft. wide alternately and the uncultivated belts between are about 3 ft. wide. The aspect is easterly as a rule and the soil very poor. Blue pine seed was dibbled in, in June, and again sown broadcast and trodden in with the foot in July. Countings on a portion of these strips were conducted as follows;—a rod 4 ft. long was laid along the strip and the number of seedlings counted in this length; if a seedling was found in the length of 4 ft. it was counted as a success.

The results were as follows :—5,143 four-foot lengths were counted : of these 3,663 were blank, and 1480 had seedlings in

them, to the aggregate number of 2,390. Hence the percentage of success is 28·8, and of failure 71·2. The soil is of a bad quality and the situation is dry, hot, and exposed, and it is to be feared that some of the existing seedlings will die. In December, grass was placed over the young plants as a protection but several have since died notwithstanding this precaution.

Blue pine has numerous enemies to contend with, when sown in the open. Birds eat the seed, grubs cut through the roots, and later on a beetle attacks the leaves.

It is intended to plant deodar along these strips at intervals of 10 or 12 feet, the idea being that the pine will grow up faster and act as a nurse ; a commencement has already been made in this respect, and about 1,700 plants have been put out. In the lower portion of this area, cuttings of willow and poplar have been used to mark the planting spots and nearly all of them have struck root and are sending out young leaves. If these cuttings should survive, it might be advisable to make an experiment on a larger scale, as if willow and poplar could be got to grow, it is possible that the problem of a nurse for the deodar might be solved. Any how the experiment would not cost much, and it is well worth trying.

The experience of 18 years in Bodyar has clearly proved that on the drier and hotter slopes, it is essential to raise some crop as a nurse first of all, and blue pine would appear to be the best for this purpose. Indigofera and other woody shrubs answer very well, but as a rule they only grow in good soil, sheltered ravines, &c. There are, scattered about Bodyar, some blue pine trees, self sown, dating from the commencement of fire-conservancy in 1872. There are not many of them, and no parent trees are visible in the area ; but the seed has been brought by the wind possibly from the heights of Moila, or by the agency of birds; plants have sprung up, and there are now several trees, 21 years old, with an average height of 24 feet, and girth of 21 inches (16 trees measured). They have already begun to shed seed, and from observations made, it is believed this seed is fertile, and a second crop is now being gradually produced on the ground. Had there been many more of them it would have been possible to underplant deodar before this, with every chance of success. The instance mentioned above of a solitary pine sheltering 11 deodar plants and giving them two feet in height above those in the open sufficiently proves this.

We also examined some sowing (July 1892) of blue pine in roughly made patches on two slopes in Ganwa. On a southerly aspect, 3,010 patches contained 1,371 blanks, and 169 patches with seedlings in them to the number of 3,973 ; percentage of success is 54·5, and of failure 45·5. The average number of seedlings is 2·4 per successful patch.

On a westerly aspect, but on a much steeper slope, 847 patches contained 397 blanks and 450 successful patches with 946 seedlings in them, giving a percentage of success 53, and of failure The average number of seedlings is 2·1 per successful patch.

Besides general inspection of the forest and measurements of the various plantations as given above, the following works were done by the students :—

307 basketted plants were put out in prepared pits in Ganwa, Sub-Compartment 7. (*a*) and (*d*).

513 patches were sown with deodar seed and several contour lines were laid out for strip sowing. Last autumn the ground had been cleared and lightly hoed up under two deodar seed bearers near the Forest Chauki, and the number of seedlings that had come up were counted. Under the first tree, belts 10 ft. wide were counted separately ; the first just above the tree contained 3 seedlings ; the second one with the tree in it, contained 18 ; then in descending order 21, 6, 5, 3, 0, 0, 0.

Under the second tree, belts six feet wide were examined ; the one immediately above the tree had 285 seedlings ; the one containing the tree had 920 ; and the three next belts below, 701, 318, and 45 respectively. This small experiment shews that deodar seed is not carried far by the wind ; generally we noticed seedlings underneath the parent tree and not out in the open at any distance.

As mentioned above, snow has done an immense amount of damage this year, a portion of a well stocked slope in the lower part of Ganwa, about one acre in area, has been shaved clean off, leaving the underlying rock quite bare. The uprooted saplings might be transplanted into large pits. All over Bodyar, plants have been bent down, through an angle which varies from 40 degrees to 80 degrees. It will be interesting to note in future years if they regain an erect position.

A small insect, probably a *Chermes*, produces a gall at the ends of the branches of spruce fir ; the bud becomes arrested in growth, thick and fleshy with scale-like leaves ; inside, around the edges, may be observed numerous minute pink grubs, which eventually develop ino flies and leave the small cone-like bud through a series of apertures. This year, we noticed very few of such galls, but in ordinary years they are quite common.

A fungus, *Œcidium Thomsoni*, also attacks the ends of the side branches in the spruce fir producing pretty yellow tassels, which turn deep orange, then red, and then black, when they dry and fall off. Neither the insect or the fungus appear to do much harm, and they do not attack, as a rule, the leading shoots.

Excursion to Moila. On the way we noticed an abandoned deodar nursery in a damp ravine shut in by trees. Such places are exposed to frost, and the elevation being 8,000 feet which is too high for a deodar nursery, the site was wisely abandoned.

The boundary pillars of Bodyar forest are made of dry rubble masonry 4 ft. cube on a plinth $5' \times 5' \times 1'$. The wooden post bearing the number is fastened to a cross piece embedded in the masonry to prevent its being pulled out. These pillars are unnecessarily large, costing Rs. 3-8-0 each.

From the top of Moila peak which is 9,058 ft. above the sea, there is a grand panorama of the country round on all sides. To the south we have the compact Bodyar forest enclosed in an amphitheatre and looking from here particularly well stocked as we could not see the bare southern aspects ; the fire line on which we were standing could be traced nearly the whole way round. To the west, we have the Chor Mountain nearly 12,000 ft. high and covered with forest except on the very summit, then more to the north, the high peaks of Chachpur and Kuphar, over 10,000 ft. and covered with *Karshu* Oak and the white birch to the top. The Pabar and Tons valleys were visible for miles, and in the distance the leased forests of Lambatach and Deota could be made out, the horizon for more than 100 miles on the north being bounded by the snowy range, conspicuous in which rose the peaks of Bunderpunch, commonly known as Jumnotri.

The grassy top of Moila itself is a high level grazing ground for the sheep and goats of the neighbouring villages, and their camping places in small hollows are common everywhere, with the piles of stones on which they keep fire burning all night to scare off leopards. On the north side of Moila we went down through the second class forest of Missau. It is open to grazing, and closed to fire, and the reproduction is on the whole very good. Here and there, the sheep and goats nibble the young conifers, and reduce them to the state of stunted bushes, described in the Journal of 1888, as follows :—

" We then passed through some forest near Kophti open to grazing, and on the bare grassy slopes we found that the conifers are 'regularly browsed by sheep and goats. The appearance presented 'by the deodar, blue pine, and spruce fir when thus treated is remarkable ; they resemble short squat bushes, much broader than 'high, with innumerable little branches and twigs ; those we saw 'were about one foot high with a thick carrot-like root and, judging 'from the annual rings, 10 to 12 years' old. We were not able to 'determine satisfactorily at what time of the year this damage is 'done, but believe it to take place during the late autumn or early 'winter, when the grass is killed by the early frost ; the conifers 'are probably also browsed when snow is on the ground."

It is stated by the local Forest guards that this browsing takes place in the summer when the sheep and goats first come up, and the young needles are fresh and juicy.

But this grazing is not very extensive except in the immediate neighbourhood of the camping grounds, and wherever there is a sufficient number of seedlings on the ground the young plants gradually grow up and form thickets, notably in the case of the blue pine. The great difference in the reproduction between the Bodyar forest with its hot dry slopes and thick matted grass, and that in the Missau Forest is most striking and the principal reasons for this will be given hereafter.

(*To be continued.*)

"Protected Forests."

In the April number of the *Indian Forester* an article headed "A plea for Protected Forests" has appeared; and though the article is both interesting and in the main justly supports the point contended for, it has I think somewhat missed the real objection to *the provisions as they stand* in Act. VII of 1878, regarding Protected Forests, and also is calculated to give rise to some misapprehension of what the law really is. It was no part of my intention in the *Manual* (and this will I hope be still clearer in my shortly forthcoming "Lectures on Forest Law") to object to making legal provision for the protection of lands which, under the circumstances, it is not worth while to treat under Chapter II. If lands are liable to be washed away (and such lands seem to be mostly in the contemplation of the writer in the April Number) it is not likely that there will be any extensive *rights of user* in them and that alone would justify their being placed under a system less complete than Chapter I describes But even so, the procedure under Chapter II would be very easy when there are no rights, for it is then very much a matter of form.

It has always been contempleted (vide the Burma Act, XIX of 1881) that there should be legal provision for the protection of forest and waste lands which (for any cause) it is not desirable to demarcate and settle expensively. The cases in which such provisions can be carefully applied are chiefly: (1) where the conditions are undeveloped, and it is not certain whether the area is really wanted as permanent forest, or whether it had not better be (ultimately) given up to cultivation; (2) where there are no rights of any kind, so that there is really no need of any action but clear demarcation, and an announcement of the public right and public control of the area, so that new comers and others in future may not imagine that the area is "no man's land" and available for them to do what they like with; (3) where there are such complications that some kind of protection, however imperfect, is better then none. And I may now add such a case as that now put forward—riverain forests where the alluvial area is liable to constant change.

But the objection to Chapter IV. is its *general* principle; that it appears to allow the forests permanently required by all social, economical and climatic conditions and possibly burdened with rights, to be *called* "Protected Forests'—although none of the essential elements of a really definite security of the area as *State property* (for the public benefit,) are provided.

Chapter II alone represents the conditions under which a forest permanently wanted for the good of the country can be fully and legally established. The whole question depends on the existence of rights (or long standing practices which are equitably

regarded as rights). All waste land belongs in theory to the State, this being one of the most ancient land rights known in India. But time, neglect, and many other circumstances have brought about a state of things in which the rights of the State have been mixed up (so to speak,) with what have become (or are allowed to be) the prescriptive rights of villages or private persons.

These are vague and indefinite in most cases. If there are no rights, no questions to be adjusted, then of course there is no serious difficulty about the procedure, even that under Chapter II becomes short and easy. But when the forest is very much needed by the people, and therefore numerous demands for grazing, wood-cutting and other rights have grown up there, it is evident that we want a permanence of the forest area, and its cultivation in such a way as to secure continued productiveness—its always going on fulfilling its useful functions ; and *that* in the long run will *not* be done if rights are not settled, if vague claims are not defined, and if it is uncertain what rights Government has and what rights other people have, and are still acquiring, by lapse of time. Chapter IV, it is evident (on an analysis of it) does *not* effect this : I cannot weary you by going into the whole case, but permit me to remind you that, in ninety-nine cases out of a hundred, what is wanted is not the knowledge (a record) that some person or persons has a general unlimited right of 'grazing' (—anything and everything at any time) or of 'woodcutting', but a power to decide : to say as a Settlement Officer, 'I admit as a fair representation of what this man, or this 'farm really needs, and what his (or its) equitably acknowledged 'right ought to be, that he can graze so many cows and oxen, so many 'sheep, (or whatever it is) in certain months, and under certain 'conditions, which are needed for the safety of the estate.' Without that however, a mere enquiry and record of rights such as Sec. 28 vaguely prescribes is of no use to the forest, and very little to the rightholders. Admittedly then, an officer could be appointed to make such an enquiry (which may be conceded by a process of inference, but no power exists to enable the officer to define or *decide* anything, nor is there any appeal against a decision if one could be given. The powers cannot be conferred by Rules* for it is an obvious principle that Rules may fill in details, but cannot be used to extend the scope of an Act, and convey distinct powers, which the Act itself does not give, and indeed rather pointedly omits. The whole difficulty was, that the Committee who revised the draft Act did not understand the subject, and they insisted on putting in Sec. 28, *not* to protect the forest, but to protect the right-holders against the wicked and grasping Forest Officer ! They perceived that they must leave it vague, for if they provided the

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* I must here point out that Section 71 is no help, no power of decision is given.

necessary apparatus of letting there be a regular officer, with power to decide and to define, and with an appeal against his order, what would become of the difference between Chapter II and Chapter IV (as altered by them)? The framers of the Act as it originally stood, always intended that, when for some reason a complete and permanent settlement was not desirable or possible, protection should be given by certain provisions, but that *no attempt* should be made to do the work of settlement, *i.e.* to define and record rights. It was always intended, that if anyone were prosecuted (which practically would rarely happen,) and he set up as a plea—'I did this because I had a right'—the plea should (if fairly probable or established,) be am entirely sufficient answer. The whole objection to Chapter IV, then, is *not* that such a chapter properly drafted is not useful in certain cases, but that an important and inconclusive procedure should not (merely to save trouble and expense,) be applied to forests in which *rights* ought to be settled once for all : and there is an obvious temptation to save trouble by declaring forests 'Protected' which, if they are in the midst of a large population and much utilized by right-holders, will—as certainly as anything can in this world be predicted—slowly but surely deteriorate and finally disappear altogether. There ought to be only *one* class of forest regularly and sufficiently established to secure its *area* from being frittered away, and its *management*, being such as will enable the productiveness—*for whatever is wanted*, whether large timber for D. P. W. or small stuff, or grazing for the villages—to be sustained.

In a "protected" forest, new rights may always he growing up unless extraordinary care is taken, and if it is once admitted that one person or another has some kind of grazing, wood-cutting or other right, it is impossible for any one to fix 'how much' or 'how many' or any other feature of the rights which is at present uncertain.

I do not know where the writer gets the idea that in a regular forest, work cannot be done till settlement is over, while it can in the other case. Certainly the Act contains no such provisions. The forest being proposed to be "reserved" is necessarily, to some extent, the property of Government ; and neither wood-cutting, nor private grazing (as it exists,) *need* stop for the settlement. All that is legally required is that fresh attacks on the soil (clearings,) should not be made *so as to introduce* fresh complications of ownership : also that new rights should not go on growing up or that rights as yet unestablished should complete a term of years by prescription. But Government is not obliged to suspend its work if any is going on, any more than a person having a plot of land in the forest would be obliged to cease cutting his crop or weeding the field ; nor would existing grazing be stopped. The whole question I may repeat, is one of the existence of rights: these, if not settled, have an awkward way of growing and spreading till in the end the attempt to contest the forest is given up. There cannot be two ways of

securing an area as a *public estate for all time.* For if one of the ways legally effects the object, the other must be superfluous. There can only be one class of legally secure forests; there may be other areas which though confessedly not secure, are placed under a certain degree of protection. It is a matter of local convenience and of a consideration of all the probabilities of the future to determine whether a secure forest-property should be constituted. The danger is to suppose, that with forest really wanted, whether by the local population, or by the State for valuable timber, you can shirk the really needed elements of legal and final security under Chapter II, by resorting to a (supposed) *other form* of permanent forest, which is really not satisfactory. Can any one point to a single 'Protected Forest' in India which *is* burdened with rights and which ought to be secure for all time, that has had the rights defined so that they cannot grow, and that is so ordered that new rights cannot arise in it? The record made under section 28 can have no other effect than that of informing Government that a number of rights either really exist or are claimed, so the Government may, if it thinks rights are numerous, *decline* to allow the forest to be gazetted. That is really the sole object and intention of the alteration. It will be remembered that in 1878 at any rate, the one (inveterate) idea prevailing in official circles was, that if a forest was much overrun by the grazing and other requirements of neighbouring villages, the one and only thing to do, was to *give it up*, without control, to the villages, and abstain from including it in the list of Government forests altogether. It is supposed that somehow it would go on (at least for immeasurably long time), supplying what the villages wanted, without any care or cultivation. At best, it was vaguely dreamed, that in time, the villagers might be induced to do something of their own accord to adopt measures of reproduction.

The securing of area and the settlement of rights is, if anything, *more* wanted in forests very much in demand for satisfying village requirements, than it is in forests which are valuable to the State as "nurseries for gigantic teak trees."

I trust that these remarks will not be taken as ill-natured or as carping at a useful and clearly stated paper of criticism. On the contrary, the appearance of such a paper ought to be hailed with the greatest satisfaction. Nothing will be more conducive to the establishment of sound ideas of Forest law in practice, than the ventilation of the whole subject and the examination of specific cases in the lights of legal principles and provisions of the Acts, such as have been, I think almost for the first time, done in the paper on which I have been remarking.

B. H. B. P.

Oxford. May, 1893.

The Revenue of the Prussian State Forests.

The annexed diagram with the following remarks taken from the Forst und Jagd Zeitung may be of interest to foresters.

The area of the State Forests of Prussia is about 2½ million hectares or, say, 6,175,000 acres. The expenditure amounts to about 50 per cent. of the gross revenue : the net surplus during the last 20 years has varied between 22 and 28 million marks, but in the last two years has reached 35 million marks.

During the past 25 years, the gross revenue has risen from 44 to 73 million marks and 10 millions of this increase has taken place in the last 2 or 3 years.

The increase in area during this period has been about 4 per cent. but about the same area has been removed from Statr forest in the extinction of rights and whilst the area given was stocked with good forest, that acquired is either unstocked oe contains only young growth.

The average sale price of the outturn has not increased ; the outturn however has increased from 7 to nearly 10 millions cubic metres.

The conclusions arrived at are that, the selling price being constant, the yield and the gross revenue have increased by 1/3rd, whilst the expenditure and the net revenue still retain the same proportion *viz.*, 50 per cent. of the gross income. The net revenue per hectare, *viz.*, from 9 to 13 marks, is twice, in some cases thrice, more in other states of the German empire, but experienced foresters have doubts whether this high revenue is not exacted at the cost of the future and at any rate a high surplus is dependent on so many circumstances that it is by itself no criterion of the skill and knowledge of the Forest Officer. The increase in gross revenue in the last few years is entirely due to more extensive fellings but it is not shown whether this increase in outturn is justified by an increase increment and therefore whether or not the future revenue of the forests is injuriously affected. It is easy to increase the gross revenue from a forest by more extensive or intensive fellings, but the aim of the Forest Officer should be not to fell more trees but to grow more and better timber.

S. E—W.

The Revenue of the Prussian State Forests.

The annexed diagram with the following remarks taken from the Forst und Jagd Zeitung may be of interest to foresters.

The area of the State Forests of Prussia is about 2½ million hectares or, say, 6,175,000 acres. The expenditure amounts to about 50 per cent. of the gross revenue : the net surplus during the last 20 years has varied between 22 and 28 million marks, but in the last two years has reached 35 million marks.

During the past 25 years, the gross revenue has risen from 44 to 73 million marks and 10 millions of this increase has taken place in the last 2 or 3 years.

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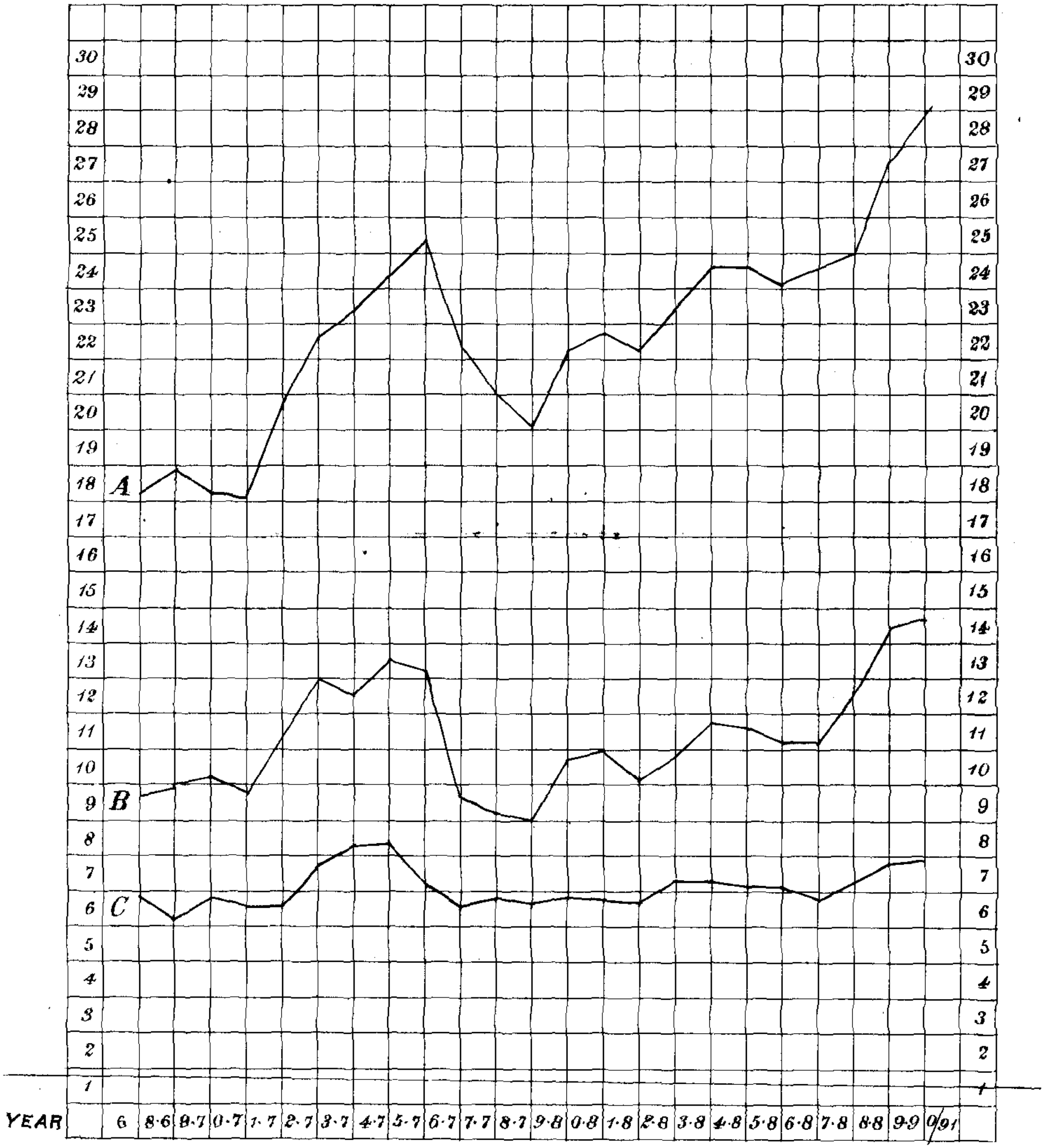
S. E—W.



A. *Gross revenue per hectare of productive area.*

B. *Net revenue " " " " "*

C. *Average price of wood per cubic metre.*

The figs. in horizontal line shew years;

those in vertical line marks.

A mark = 1 shilling.

A hectare = 2.47 acres.

Forests Versus Insects.

It is not only in the cases which attract general notice, as in that of the sal trees in Assam which are said to have been completely defoliated throughout two hundred miles of Forest in 1878, or in that of the teak plantations in Lower Burma which have recently been attacked by an insect reported as doing as much or more damage than an ordinary forest fire, that injury is occasioned

to forests by insects in India. For damage is constantly going on almost unnoticed upon a scale which interferes to a serious extent with the operations of the Forest Department. For proof one need go no further from the Forest School than the nearest highway, where nine-tenths of the young *toon* trees that line the road are stunted and their value as timber greatly reduced by the *toon* borer, which destroys the leading shoots almost as fast as they are put forth. Again, a walk down the Dehra Canal road brings one to spendid clumps of bamboos whose value must be lowered in a very great degree by the tiny borer which so frequently reduces dry bamboos to powder. But it is useless to multiply instances, for throughout the whole period of the growth of almost every forest tree in India, from the seed which is likely as not to be destroyed by weevil, to the timber which is liable to be eventually eaten by white ants, there is hardly a moment when it is not to some extent subject to attack from one kind of insect or another.

Something can no doubt occasionally be done, when the damage is noticed, but in the great majority of cases, curative measures are too costly for every day adoption in the forest. The question therefore of the general measures which are practicable for reducing liability to attack is of very great importance. The subject is one upon which the entomologist by himself is unable to express an authoritative opinion, for the matter largely depends upon practical considerations which the executive forest officer is alone in a position to weigh.

The majority of destructive forest insects are said to be continuously present in greater or smaller numbers in the forest. Under ordinary circumstances they are kept down by natural enemies and disease, but they are always liable to increase. A hundred eggs is by no means a large number to be laid by a single insect, and as, in the majority of cases, several generations can be gone through in one year, multiplication is excessively rapid, whenever abundance of food and absence of natural enemies and disease happen to occur in conjunction with weather that is favourable to the development of the species.

The presence of dead and dying wood in a forest undoubtedly tends to promote the multiplication of boring insects of all kinds. This is particularly the case with bark borers which often do a great deal of damage. Again, fallen leaves and litter, when left upon the ground, serve to shelter the pupæ of such insects as the destructive Teak *Hyblæa* from the birds which would otherwise destroy them. Before systematic protection was organized, forest fires probably served to some extent to clear the ground of litter, though the service thus rendered was much more than compensated for, even so far as insects were concerned, by injury to the vitality of the trees, resulting in the multiplication of boring insects. In forests that are protected from fire, and where the litter is not removed artificially, white ants are believed to be about the most important agents for converting dead wood into valuable soil.

Against this must be balanced the damage these insects occasionally do to freshly planted trees, and their ravages in dry timber and other substances not intended for the entertainment of Termites. If white ants could be extirpated elsewhere it would no doubt be most injurious to encourage them in the forest but this not being the case it may very possibly prove that the protection of their nests is in many cases beneficial upon the whole, as tending very materially to reduce the amount of dead wood and litter of all kinds. The actual removal of dead wood and litter from the forest is no doubt most desirable wherever it is practicable, but the question of when this is the case must depend very largely upon local conditions. In any case, the removal of the leaves, though desirable from an entomological point of view, is not likely to be approved by the forester who considers them useful in other ways to the trees. When it is impossible to remove dead wood altogether, stripping off the bark and burning it is the next best thing, as wood is much less liable to harbour injurious insects when deprived of its bark. Prolonged immersion of timber in water is also said to be useful for the same purpose and is already largely utilized in the case of bamboos, though it is difficult to say to what extent it is to be recommended unconditionally for other timber.

Another feature of general importance is the fact that almost every destructive insect prefers some particular species of tree for its food, though it may also attack other trees to a smaller extent. A forest therefore which consist of a mixed assortment of different kinds of trees offers less opportunity for wide-spread injury than one which consists chiefly of single species. For the trees which are not liable to attack from the particular insect which happens to be in the ascendant, not only escape themselves but also tend to confine damage to the spot where it originally started. This fact has been largely taken advantage of within the last few years in the case of the destructive *nun* caterpillars in the forests of Central Europe where belts were formed round infested areas by clearing away the spruce undergrowth which was found to be chiefly liable to attack.

Again, the importance of protecting insectivorous animals of all kinds, and especially insectivorous birds, is very generally appreciated. The number of destructive insects destroyed by birds in India is believed to be stupendous, (1) and it is most desirable to afford every possible protection to the species that are of use. Care however should be taken to discriminate between such habitually insectivorous birds as the ground thrush (*Pitta*), which may be looked upon as purely beneficial, and such species as the rosy pastor starling (*Pastor roseus*) which is said to do more harm in devouring seed than good in eating up insects.

(1) Major Bingham writes with regard to the destructive Teak Hyblæa in Burma, that a plantation attacked by this insect is a wonderful scene of activity, as numbers of Jungle fowl, ground thrushes (Pitta) and insectivorous birds of all kinds crowd to the spot to feed upon the caterpillars.

We have seen that the multiplication of destructive pests depends to an enormous extent upon the presence or absence of parasitic and predaceous insects and of disease. These are elements of the very greatest importance and deserve careful consideration, though comparatively little has been ascertained upon the subject in India. Extensive experiments, in some cases attended with promising results, are being conducted in different parts of the world in connection with the possibility of controlling them artificially. The matter may not improbably become of immense practical importance hereafter, and in any case should prove most interesting for forest officers to study, though it has not yet advanced to the stage of immediate utility.

CALCUTTA,
19th May 1893. E. C. COTES.

The Grasses of the Sandur Hills.

We have received from the Madras Government the Report of the Government Botanist Mr. M. A. Lawson on some of the grasses of the Sandur Hills in Bellary which were sent to him for identification. The following remarks of Mr. Lawson on the condition of the specimens sent, shew that there is reason to hope that the practical teaching in the drying and preservation of plants now taught at the Forest School will not be wasted.

" The specimens were not properly prepared and had to be ' macerated in water, separated, and re-dried, before they could be

'named. The condition in which they are returned is the one in
'which they should have been sent."

Number.	Vernacular names.	Botanical names.	Where they grow.	Whether they are reproduced from roots or by seed.
1	Bothai hullu	Anthistiria	Grow in tussocks profusely at the bottom of hills ..	Reproduced both by seeds and roots. Used for thatching huts.
2	Jundigi do.	Do. No. 1	Scattered growth ; grows best on the slopes	Reproduced by seed. Cattle like it when it is young.
3	Iskasi	Do. ,, 2	Grow best at higher elevations and also profusely ..	Reproduced both by the seeds and the roots.
4	Nagamuruku grass ..	Anthistiria	They grow least in the ravines and shady places	Reproduced by seed. Good fodder grass.
5	Kadayadu hullu ..	Panicum fimbriatum ..	Growth scattered and not profuse ; will be found both at the top and the bottom.	Do. do.
6	Chippigi do. ..	Panicum Petiverii ..	Scattered growth everywhere, but not profuse	Do. do.
7	Aula do. ..	Panicum miliaceum ..	Growth scattered ; does not grow profusely anywhere ..	Do. do.
8	Korrala do. ..	Setaria glauca	Scattered growth, but not profusely. In some cases both on the top and at the bottom.	Do. do.
9	Sajji do. ..	Manisuris granularis ..	Grow best at higher elevations and also profusely ..	Do. do.
10	Kulthapri	Arthraxon lanceolatus ..	Grow best in a little rocky place and at higher elevations.	Reproduced by roots.
11	Kempu kasari ..	Heteropogon contortus ..	Grows profusely everywhere, especially at higher elevations.	Do. both by seeds and roots.
12	Semkini hullu ..	Do.	Grow profusely on the tops of hills and rocky places ..	Do. by seed. Good fodder grass.
13	Bilaykasari	Do.	Grow best at higher elevations, but it will also be found below.	Do. both by seeds and roots.
14	Sennakasari	Do.	Do. do. do. ..	Do. do.
15	Saday hullu	Do.	Grow best at higher elevations and also profusely ..	Do. do. good fodder.
16	Chiti bothai	Andropogon Schœnanthus var. genuina.	Grow best at higher elevations, but it will also be found below.	Do. do.
17	Maravali hullu ..	Andropogon pertusus var. insculpta.	Growth scattered both at the bottom and at higher elevations.	Do. by seed.
18	Bagati do.	Chysopogon gryllus ..	Grow best at higher elevations and also profusely ..	Do. both by the seed and roots. Best fodder grass.
19	Naribalu do.	Aristida cœrulescens ..	Growth scattered ; will not grow anywhere profusely ..	Reproduced by seed. Good fodder grass. Cattle like it when it is young.
20	Kadu ragi	Eleusine ægyptiaca ..	Grow best on the slopes	Reproduced by seed.
21	Gubbu grass	Eragrostis megastachya ..	Grow best at higher elevations and also profusely ..	Do.
22	Godi hullu	Do. bifaria ..	Scattered growth both on the slopes and the top, but not profuse.	Do. Cattle like it when it is young.

The habit of these grasses is erect. They flower in the latter part of September and in October.

Amended descriptions of Reserved forest boundaries.

The following Circular has recently issued on this subject. "Cases arise in which it may be desirable to publish, by means of a 'fresh notification, amended descriptions of the boundaries of forest-'reserves already notified under section 19 of the Indian Forest Act, 'or under other forest enactments. It has been ascertained that 'there is no legal objection to this course, if the fresh notification 'merely provides for the substitution of a more exact and definite 'description of the boundaries for that which was originally notified, 'and which, though purporting to describe the boundaries as they 'existed at the time, has subsequently become incorrect or proved to 'be open to misconstruction.

'The procedure permitted in the foregoing paragraph must not 'be held to extend to any such alteration of the boundaries on the 'ground as would involve either the inclusion of new areas or the 'exclusion of any lands which have been declared by the previous 'notification to be reserved forest. Such changes require either a 'new settlement of the additions it is proposed to make, or, in the 'case of disforestation, the previous sanction of the Government of 'India."

Ethnology in India.

We have received from the Government of India papers relating to the Ethnological enquiries now being carried out all over India with Mr. H. H. Risley, of the Bengal Civil Service, as general Editor and referee. The enquiries will, of course, bring out and record an immense amount of valuable information, and, though we see that the Forest Department is not mentioned in the orders, we feel sure that there are many Forest Officers who might be consulted with great advantage, for there are probably few of its servants in India from whom Government could obtain information regarding jungle tribes and their manners and customs so easily as from those who manage its forests.

Analysis of the bark of Cassia Auriculata.

We have received official papers regarding some analysis of this bark so well known under the name of 'Avaram' or 'Tangedu throughout Southern India, which were made by Mr. D. Hooper, the Nilgiri Quinologist, for the Mysore Forest Department. Apparently, at first, the specimens sent were of young twigs only and so the Inspector-General of Forests and Plantations of Mysore complained to the Government of Madras and on enquiry the fact

was reported. As Mr. Lawson very properly pointed out, "the chemist is entirely dependant upon those who send articles for analysis for their sampling." Mr. Hooper's report runas as follows :—

" The Inspector-General of Forests quotes an analysis of tangedu 'bark made by me four years ago and notices a discrepancy between 'the results and those obtained on the analysis of a sample of the 'bark made in England by Professor Hummel. The sample 'was supplied me by Mr. Cameron and it consisted of young thin 'bark in small quills and contained much chlorophyll. It yielded 'the following on analysis :—

'Tannin	11·92
'Insoluble tannin (phlobaphene)	2·30
'Watery extract	22·35
'Ash	4·15
'Moisture	7·26

'On receiving this letter from the Inspector-General of Forests, 'I at once wrote for a sample of tangedu bark as used in the tan- 'neries in Mysore district, and Mr. Cameron very kindly supplied 'me with a 3 lb. sample.

'This bark was evidently from an older shrub as it was thicker 'and in larger quills, and the tincture of the bark, made with rec- 'tified spirit, was brown and not green as in the former case. It 'yielded on analysis the following constituents :—

'Tannin	20·12
'Insoluble tannin (phlobaphene)	4·90
'Watery extract	29·00
'Ash	6·40
'Moisture	7·80

'The amount of tannin was the mean of two separate determi- 'nations, and this result was controlled by another estimation made 'by a different process. After exhausting the bark by means of 'spirit and water, a rich coloring matter was dissolved out of the 'bark with alkaline solutions. The tannin gave a blue-black colour 'with iron salts and therefore resembled gallotannic acid.

'It will be seen from the above analyses that the discrepancy 'referred to in the letter from Mysore was due to the fact that I 'was supplied with some young bark of *Cassia auriculata* in the first 'instance, and results were made to compare with the analysis of 'maturer specimens of other astringent drugs. That there is a great 'difference in the amount of tannin in the bark taken from different 'parts of the tree will be demonstrated from the results obtained 'recently in analysing some *Acacia decurrens*. The twig bark con- 'tained 14·7 per cent. of tannin, the small or upper stem bark 25·4 'per cent. and the thick or lower stem bark 33·4 per cent.

'I am glad to have had this opportunity of examining the well 'known tangedu bark again, and trust the analysis will be interesting 'and satisfactory to the Inspector-General of Forests, Mysore, and 'to all who are concerned in the economic products of this country."

Chakla Drogmula.

(*Continued from page* 279.)

I must now hark back to Drogmula where demarcation was started ; the village is situated in a veritable plain dotted here and there with large walnuts, a chinar or two and hundreds of fruit trees, some in regular orchards and others scattered about singly. The chinar does not thrive in this part of the country, the soil being probably too hard, as the tree appears to favour a sandy soil with a good supply of water. At Drogmula village there is one very curious old tree, the original trunk is a [redacted]ckened and hollow shell, but the base close to the ground has [redacted] great size, perhaps 40 feet in circumference, and fi[redacted] some 50 other stems, these in turn as the[redacted] of an ordinary tree, dying at the top and becoming [redacted] whole looking like a small grove of chinars. Here also is to [redacted] found the crooked and knotty *bér* (Zizyphus oxyphylla), [redacted] handsome sticks can sometimes be obtained from this. Dema[redacted] tion was begun in the forest adjoining this village and at first [redacted] was great consternation among the villagers who imagined [redacted] all sorts of terrible things were going to happen from the p[redacted] up of the pillars. An idea got about that no land which ha[redacted] even once ploughed, would be included, consequently ther[redacted] rush to hack down a few bushes and drive a plough then a[redacted] and then claim it as cultivated land. Some of the attem[redacted] particularly barefaced, the ploughs having been run along [redacted] day before. Sometimes the people were very obstinate, [redacted] they could not exist if the pillars were erected and windin[redacted]h the usual threat, dear to the Kashmiri, of going aw[redacted]he Punjab, though what they would do there is is difficu[redacted]y: they would soon find the heat there somewhat differ[redacted]hat of their own country, for Jack Kashmiri does [redacted] the heat any more than we do. However, they were quiete[redacted] after a time and went on with the work, but it gets monotonous to have to meet and overcome the same silly objections in every new place. As a matter of fact we are very liberal, excluding not only all really cultivated land but also any that is cultivable, even at the expense of small patches of forest. We seldom have to clear lines through jungle, which delays the work very much, but can generally find an open line along the edge of the actual

forest ; the plan is to so place the pillars or posts that standing at one, the next in either direction can be readily seen ; the posts are about 7 feet long of which one foot is sunk in the ground, then a stone pillar is built up round the post to 3 feet above ground leaving 3 feet of the post visible, this is quite a sufficient landmark and inexpensive. Here and there at prominent angles pukka pillars will be built, this will be done hereafter, the important thing is to get the boundary marked out in order to prevent any more land being broken up for cultivation. I was rather amused at one fine old Goojur who began the usual whine about *baubád hojate* &c ; I said "you are a *pardesi* surely you came from the Poonch State," he admitted the soft impeachment. I then told him he had no right to anything, the land being the property of the Kashmiris, but he said it was his *Kismat* to come long ago, so I retorted that I quite agreed and it was also my *Kismat* to come and put up the pillars : this struck him and he grinned cheerfully admitting it was so, and we became friends once more ! But the most curious idea of all, is one that these people have to the effect that I have leased the Kashmir forest for two years and they believe or pretend to, that I want to shut them out of the forests. It seems [illegible]ous that, although I have been two years in the State, they [illegible]acts. It would appear that there was [illegible]e forests to a speculator just before I [illegible]re likely an offer was made by some [illegible] customer of a large sum down, if he got a lease. Luckily it [illegible] not entertained, or there would not have been much forest left ; [illegible]villagers probably heard of this and put two and two together [illegible]ing it five!! The present position of affairs is a curious one, [illegible] this Department is somewhat in the position of a Bank on [illegible]ch a run has set in, the run being to clear as much land as [illegible]ible before the pillars are put up and then declare it a ten [illegible] old field. Not long ago, I happened to go to an eminence [illegible] afar off espied unmistakeable signs of a clearing in a forest [illegible]ss the valley ; I at once sped across and found to my disgust [illegible] a Khyberi, of whom there is a settlement in this part, had [illegible]un to nibble at a grand plateau, covered with a fine forest of [illegible] pine, just as a mouse would nibble a corner of a cheese. I had therefore to stop work at Drogmula and hurry off to the place and for three days we were hard at work encircling this tableland with a line of pillars. While engaged in this work we found, alas,! that another miscreant had cultivated a small area in the very centre of the forest : we hope, however, to get rid of him as it is pretty certain this was unauthorised and not entered in his *Kheirat*. The wearying part of it all is that we know well enough this sort of thing is going on everywhere : and what is far worse, the Goojurs from Poonch squatting in the heart of the forests, clearing and building villages. Oh ! for half a dozen of my old friends of the Forest Department to run the thing through sharp and put an end to these little games ! !

As this Drogmula Chakla contains the only really valuable deodar forest in Kashmir proper, it has been decided to build a small forest house here. A lovely spot has been chosen on a small open plateau at the foot of the main ridge, it is surrounded by deodars and other trees and elevated well above the plain, and is just inside the forest boundary. A small stream of the purest water runs, just below, and while being far enough from villages to escape the village nuisances in the shape of dogs and cats, still near enough for all purposes of supplies and labour. It is hoped the house will be finished this summer, if so any Forest friends who find themselves in that locality are invited to make use of it, and they will not repent spending a few days in this beautiful spot.

The forests near Drogmula village contain perhaps an equal proportion, roughly speaking, of deodar and blue pine, and there are still fine trees to be found here and there, but they are not to be compared with the forests near Kandi which are almost pure deodar and have many more first class trees. The reproduction is very good in both places in favourable spots and as last year was a good seed year the ground is now covered with thousands of seedlings and as there is not much danger of fires now, it is hoped that many will survive. If so, it is pretty certain that the re-stocking of blank spaces will be assured ; the grazing will hardly affect it since very few cattle graze inside the forest, and goats and sheep go to the grassy uplands beyond the limits of the deodar. Having seen a good deal of deodar forest in my time, I have pretty nearly come to the conclusion that we need not be so ve[redacted]
particular about cattle grazing, in fact, I would almost go so far [redacted]
to say that it would be beneficial in many places in keeping d[redacted]
the rank herbage, and if my friend A. L. M. in Chamba, c[redacted]
only he induced, Mr. Editor, to send you his views on the su[redacted]
the question might he threshed out.* I always think of Co[redacted]
ment No. 6 in Kalatope, which has never been closed to [redacted]
and yet its natural reproduction is wonderful ; I first saw [redacted]
back as 1870 and 1871; and when I held charge of the [redacted]
in 1881, I went carefully over it and was surprised beyo[redacted]re
to see how the young trees had gradually grown beyo[redacted]ch
of cattle, and how the blank spaces were being gradua[redacted]ked;
of course the number of cattle using the pasturage [redacted]l but
then so it is almost everywhere in the hills. On the other hand in Kainthli and Bakani (Chamba) where no grazing whatever is allowed, it has been found that plants put out are completely choked by the strong growth of grass and other herbage.

(*To be continued.*)

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*Note.—We shall be glad if A. L. M. will respond to this invitation.

Hon. Ed.

Forest fires in France.

We read in the *Revue des Eaux et Forêts* that owing to the drought there have been some serious forest fires in different parts of the country. And the worst is that they were clearly due to incendiarism. Near Alençon, parts of the forests of Perseigne and Ecouves were burnt, mostly Scots pine. In the Landes, about 137 sq. miles have been burnt over and enormous damage done. Special measures have had to be taken and several persons have been arrested, one of them actually in the act of firing the forest of Teich.

Forest Fires in England and America.

he following extracts shew that the present phenomenally ason in England has been productive of serious forest con- ions. The results of fires in America as described in the last t are simply appalling. They shew, if anything does, the of an American Forest Department, part of whose chief ss would be the organization of fire-protection and fire pre- n works on a gigantic scale.

EVENOAKS.—A fire has been raging at Sealchart, near oaks, and about forty acres of valuable underwood has been yed.

RUNDEL.—Shortly after noon on Sunday a man lighted his nd threw the match on the bank of the main road between Pulborough and Arundel, Sussex. In an instant the grass and bracken took fire, the flames spread to the plantation at Watersfield Towers; and, in an incredibly short time, more than four acres of fir trees, shrubs, heather, and bracken were blazing furiously. The fire was confined to the plantation, which was extensively damaged, large numbers of trees and choice shrubs having been consumed.

AMERICA.—The forest fires in Northern Wisconsin, a portion of Minnesota, and the upper peninsula of Michigan continue to spread. In Minnesota the territory attacked by the flames extends over fifty miles, and includes eight new mining towns, four of which

have been completely destroyed. In Wisconsin, the fire is in scattered patches. Many small towns have been burned in the tract of country along the shore of Lake Superior, between Michigan and Minnesota, a distance of ninety-six miles, the flames embracing nearly 8,000 square miles. Ashland and other large cities are in danger. It is estimated that 100,000,000 square feet of pine have already been burned, and heavy rain can alone check the progress of the conflagration.

Opening of closed forests in .France.

In consequence of the severe drought in France orders have been issued to Conservators of Forests to do all in their power either by allowing pasture in closed forests or by concessions of cutting grass, leaves, etc, to assist the owners of cattle in getting over their present distress. *Revue des Eaux et Forêts.*

The Rights of Khonds.

The Khonds of the Mohiri hills in the Ganjam district submitted a petition last year to H. E. the Governor of Madras setting forth certain grievances for which they craved redress. The first was that the fruit trees on their lands, instead of being left to their enjoyment, are leased out in auction by the Forest Department; second, that the officers of the Forest Department have abolished their ancient privileges of taking timber for ploughs, fuel, house-building, &c.; and third, that they are no longer permitted to clear jungle for cultivation. As regards the first grievance, Government and the Board of Revenue agree with the Collector that the Khonds deserve consideration. The old assessment on their lands was fixed with reference to both cultivated land and fruit trees, while the present assessment, which is in excess of the old, is calculated on the land alone. The present assessment was so fixed as to give nearly the same average rate per acre as before, but it stands to reason that a village which could afford to pay an average rate of Rs. 1-2 per acre for wet and dry land as long as it had also a number of fruit trees free of charge, can no longer afford the same rate when deprived of the trees. The loss to the Khonds can be estimated by the fact that the produce of these trees is now leased out at an annual rental of Rs. 421, but this does not represent their full value to the Khonds, which may be fixed correctly at Rs. 650, which is a great deal in a total assessment of Rs. 1,962 for the Mohiri hills, or roughly, a

third of the present assessment. But it is not intended to restore the old privilege of the use of forest produce free to the Khonds as it would not benefit these ignorant hill people, but would eventually go into the maws of low country sowcars. In fact, the Collector believes that the complaints really emanate from the latter and the Khonds are merely the "stalking horse" of the sowcars, to whom they are heavily indebted and who hope to make a profit from forest produce under cover of Khond rights. The fact of these unfortunate Khonds being in the clutches of the sowcars is proved by the fact that the patta lands of the village of Niliguda have actually passed by Civil decree to the hands of a money-lender, Jodda Naiko, of Berhampore, in satisfaction of debts due to him. To allow the Khonds the usufruct of the trees in the forest reserves free of charge is also most objectionable from a forest point of view, and to give them the free use of the trees outside the reserve would remove but a small part of their grievance, while to reduce the assessment will be a boon to all and should benefit the Khonds and not the money-lender, excepting where the patta has actually passed to the latter. Government has, therefore, decided to compensate the Khonds proportionately for the loss of usufruct of the trees in the forest reserves only by reduction of assessment, and to restore to them, if they prefer it, the unrestricted enjoyment of all trees situated in the waste lands outside the reserves. As regards kumeri cultivation or clearing jungle for cultivation and the cutting of wood, the Khonds cannot be said to have any legal grievance, for the former was a privilege and not a right, and had to be put a stop to in order to prevent the denudation of forests. The Khonds have liberty to cut wood, bamboos, &c., to any extent outside the forest reserves free of charge for all private purposes, and the area excluded is sufficient to provide for their necessities for many years to come.—(*Pioneer* May 1893.)

'The Panoram.'

A photographic camera, which it seems probable will in the future play an important part in the mapping of unsurveyed countries, has been invented by Colonel R. W. Stewart, R. E. and Mr. Tweedy of Plymonth. It has the advantage of being smaller then an ordinary camera of the same capacity, and is also lighter, all the fittings being made of aluminium. It is easy to manipulate, and not likely to get out of order. The instrument con ists of a rectangular box, whose length from back to front is a little more than the focal length of the lens to be used, its height is somewhat greater than the width of the film (for an 8-inch spool the height would be just 9 inches), and the breadth is a fixed dimension of 5 inches for all sizes. This Camera rests on a circular disc, forming the head of the tripod-stand; to the bottom of the box is screwed, in a central position, a

tubular arbor fitting into a socket in the disc and the camera revolves freely on the stand; the box opens down one of its vertical edges, so as to give access to the hinder part of the camera or roll-holder: in this roll-holder are fixed four vertical rollers. The first of these has the tissue supplied by the Eastman Company wound on it, the second and third rollers serve to keep the film in the focal plane; and the fourth, which is called the winder, is actuated by a clock motion, with fly escapement, placed in the front part of the camera, the fly being normally blocked by an arm actuated by a pneumatic ball and tube of the ordinary kind. When required for use, the camera is set up on its stand and levelled, the clock is wound up, the slit aperture adjusted, and a suitable stop put in; the camera is then turned round till it points to the left hand of the view required, the pneumatic bulb is squeezed when the clock starts working, and the camera begins to rotate, and continues to do so until the right-hand corner of the view is reached; the bulb is then relaxed, the clock stops, and the camera ceases to revolve. This is but a very general description of this ingenious instrument, which if used at each end of a base will give the angles between all objects photogrphed. The speed of rotation of the camera itself, and the rollers on which the film is wound, being all actuated by one motor and connected with one another, the ratios of motion must remain the same, and as the rates of such motion can be regulated by altering the ratio of the diameters of the roller and its pulley, it follows that the true rate of motion can be found. In the larger form of camera the films are rather more than 5 feet long, when photographs of the whole circle are taken, in which case they are developed by being primed on to the periphery of a drum, mounted on a horizontal axis, the sensitive surface just dipping into a dish holding the developer, the drum is then rotated until development is complete.—(*Geographical Journal.*)

Wayside Planting by Village Improvement Societies.

In the planting of trees by village improvement societies both use and beauty should be included in "improvement." What is useful and beautiful in one case may be unnecessary and unpleasing in another. The great aim should be appropriateness. For instance, no tree is more suitable for shading village streets than the Elm, its high arching branches affording ample shade for comfort and not enough to keep the road in a muddy condition after rain. The old New England towns owe much of their charm to the wayside Elm. I refer especially to villages and towns where houses and shops are close together. Outside of towns, on inland high-roads, long level stretches of Elms may be used effectively, especially where clusters of houses at short intervals form a semi-

detached village. There are many other fine shade-trees which may be planted for variety:—the Oak, Maple, Beech, Chestnut and Linden. The Tulip-tree has recently been suggested for roadside planting, but it is not a graceful tree for this purpose.

For a shade-tree along much frequented inland roads, the Elm has an evident advantage over conically shaped trees. It is admirably adapted, also, for planting on home and school-house grounds and for shade in fields. Along less frequented roads, in many places, no trees should be planted at all, I have in mind a country road where occasional White Birches had grown up irregularly, and Maples had recently been planted an either side. In several instances a young Maple was set out directly under a good sized Birch. The new trees might have been grouped naturally at intervals for shade and thus made to harmonize with the irregular Birches, but the effect of this planting was formal in the extreme. I know also a triangle by a country highway where a few Pitch Pines at one end have been left in a group. I doubt if any one would have thought of planting Pines in such a spot in such a manner, but the effect of this natural arrangement is both interesting and beautiful.

As a rule, our country road-sides are at their best when planted by nature. Open views on one or both sides of the way, alternating with shady spaces, are vastly more attractive than continuous, monotonous, artificial planting. Occasionally we see a piece of road on which trees would be an improvement, especially where a new way has been cut through a bare region. But often nothing is wanted beyond leaving the bushes and vines unharmed. Now and then there is an obtrusively ugly spot where an adjoining bank of the highway has been dug out for gravel or blasted for rock. In such a spot, a clump of English Beeches or White Birches in the foreground would quickly soften the effect. In repairing our roads, care should be taken not to disturb the wild Roses, Barberries, Elderberries and many other delightful shrubs and flowers where they will flourish and multiply if left alone ; if these have been disturbed it would be well to replace them.

I would urge, also, that our country roads be not widened unnecessarily. In villages and towns wide roads are important, but in the country, narrow roads are, as a rule, much more picturesque. As to the useful side of the question, Professor Shaler, in a recent article on the "Betterment of our Highways" writes "In this country as well as in most of the states of Europe, the tendency is to make the road-bed a good deal wider than sound practice dictates. A part of the badness of our American roads is generally due to the fact that the tracking is far too wide to be effectively maintained. In this, as in many other of the grosser arts, we may well take a lesson from the ancient Romans, perhaps

the earliest skilful road-makers in the world. Their roads were, indeed, much narrower that those which are commonly found in our country districts."

If more trees are desired for a tree-lined sea-shore road with occasional stretches affording glimpses of the ocean, other kinds than inland Pines should be chosen. These should not be set regularly in a row, but in occasional groups. Willows, and in some especially adapted places a row of Lombardy Poplars, harmonize with marsh or sea. An objection to Lombardy Poplars may be made because they are not long-lived; but where they are planted at rare intervals for beauty, not for shade, they can be replaced after a number of years.

I should suggest that these three points be borne in mind: Where continuous passing and frequent lounges close to the road (as in village streets,) demand shade-trees, there artificial and regular tree-planting, especially of Elms, is appropriate both for use and beauty. That in improving country roads outside of villages, we should remember that improving does not necessarily mean changing in effect apart from keeping the road in order. That what may be a most charming addition inland may be inharmonious by the sea; and that in every case we should consider whether we are working for use or for beauty, or for both combined, so that each result may be appropriate.—(*Garden and Forest.*)

THE

INDIAN FORESTER.

Vol. XIX.] **September, 1893.** **[No. 9**

A tour in Jaunsar.

April 27th. On the road from Bodyar to Koti-Kanásar, we noticed the natural reproduction of Deodar and Blue Pine, which is particularly good in the lower portions of the Missau block. This young crop is entirely due to fire conservancy, which was instituted in 1872, and it has come up on favourable aspects, and under certain conditions, in spite of grazing. The following reasons are suggested in the Journal of 1891 for the excellence of this reproduction as compared with that in Bodyar :—

" The soil of the Missau block is deeper and contains 'more moisture than that in the Bodyar block. The greater 'amount of moisture is due to the impervious nature of the shale 'or slate in the former block, and to the extremely permeable nature 'of the limestone, which is the prevailing rock, in the latter. Rain 'falling on limestone passes through it at once. The Missau block 'lying on northern and western slopes receives less sun and is 'generally cooler than the Bodyar block, which looks south and 'east. More snow falls on the slopes above the Missau block, this 'melts more gradually, allowing a larger portion of the resulting 'water to infiltrate into the soil and sub-soil. The loss of moisture 'by evaporation is also less.

'Shale decomposes readily to form a soil rich in clay, 'while limestone decomposes very slowly and forms a very shallow 'poor soil, the purer the limestone the shallower the resulting 'soil.

'The altitude is less, the temperature is consequently greater, 'the growth more vigorous and natural regeneration favoured.

'The presence of mature Kail and Deodar trees on the slopes 'higher up in the Missau block capable of producing fertile seed 'in large quantities. The absence of seed-bearers in Bodyar block 'and the thick matted growth of grass which prevents seedlings 'from germinating.

'Deodar is not eaten by sheep when grass is available, and 'there is still plenty of grass in the block. Kail is not generally 'eaten by cattle owing to the great quantity of resin it contains 'and the consequently unpleasant taste of its leaves.'

In the portion below Asmari Chak, we found the annual shoot of deodar in the open to be 24 inches, while that of blue pine was 30 inches. The further we get away from the seed-bearers the less deodar there is in proportion to blue pine, the seed of which is light and is carried further by the wind. It is in these lower portions, where the deodar is not so numerous, that cleanings are urgent, as the principal species is more likely to be suppressed. In 1890, cleanings were undertaken in this block, and now the blue pine are all dead. When a girdled pine is dead, the roots become quite rotten and it is liable to be blown down in a storm, or to be brought down by snow ; we noticed several instances of the latter, and the damage done to the deodar is considerable. Did funds and time permit, it would be better in the interests of the crop to cut down the blue pine, at the time of the cleaning, as the fall of the sapling can then be easily directed ; but as nearly 100 acres of this kind of crop in the Deoban range have to be operated upon every year according to the working plan, it may not be possible to do otherwise than girdle the large saplings.

The wood of the girdled pine has been extensively attacked by the larvæ of a Scolytid beetle ; it is not likely that any sound trees are injured by this insect, we saw no traces of this either last year or this.

At Koti-Kanásar, some of the students girdled or cut down blue pine in the Kophti block below the path to Deoban, and freed 775 deodars ; they also received instruction in Abney's level, as used for finding the heights of trees. The area girdled last year was inspected and it is found that the pine were beginning to show symptoms of decay.

We were there too short a time to count annual rings, but the following measurements were made by the students in 1888 and 1891 :—

In 1888, they counted the annual rings on three deodar stumps close to the camping-ground, with the following results :—

Inches from centre.	*Number of rings.* I.	II.	III.	*Inches from centre.*	*Number of rings.* I.	II.	III.
1st ...	8	11	6	13th ...	14	3	12
2nd ...	5	15	6	14th ...	18	2	5
3rd ...	5	35	6	15th ...	7	4	5
4th ...	3	6	3	16th ...	8	10	8
5th ..	3	2	7	17th ...	10	6	5
6th ...	4	6	6	18th ..	12	5	5
7th ...	5	7	6	19th ..	10	7	4
8th ...	7	3	5	20th ...	9	0	7
9th ...	5	10	7	Add for height			
10th ...	4	3	11	from ground	10	10	10
11th ...	6	4	15				
12th ...	6	5	23	Total	159 yrs.	154 yrs.	162 yrs.

	I.	II.	III.
Girth	11'	11'·4"	11'
Mean radius	20"	19"	20"
Age when tree attained girth of 6 feet = 11½" radius	58	104	89
Average No. of rings per inch radius	7	7	8

In 1891, the rings were counted on mean radii of 3 Deodar stumps : the results are tabulated below :—

Inches from the centre.	Number of Rings.		
	1st tree.	2nd tree.	3rd tree.
1st	12	9	14
2nd	6	7	11
3rd	12	8	9
4th	14	6	4
5th	6	11	10
6th	4	9	6
7th	3	7	10
8th	3	9	9
9th	4	14	10
10th	3	9	12
11th	2	6	11
12th	4	7	9
13th	4	7	9
14th	3	7	6
15th	3	8	6
16th	4	9	5
17th	5	5	6
18th	8	...	5
19th	4	...	7
20th	8	...	9
21st	3	...	7
22nd	3	...	8
23rd	4	...	6
24th	3	...	10
Add for height above ground ...	5	5	5
Total ...	130	143	205
Mean radius in inches ...	...	16	20
Age when tree attained girth of 6 ft.	71	98	100
Average No. of rings per inch ...	6	9	9

The mean of these observations gives 88 years as the age in which a deodar, in this forest, would attain six feet in girth. The Working Plan calculations, probably made from a greater number of observations, lead to 80 years ; the difference is not great.

The deodar trees in the small temple grove were measured with the following result ;—

	Girth.				*Height.*
1.	18′9″	...	...	...	122′
2.	15′	...	...	...	145′
3.	11′2″	...	...	...	158′
4.	10′11″	...	...	...	160′
5.	10′9″	...	..	...	145′

In counting annual rings, the best plan is to measure the longest and shortest diameters, to add them up, and divide by 4 ; then find and mark the mean radius corresponding to this, there will generally be two, and to count and record the rings in every inch. We can thus ascertain the age at which the tree attained any given girth. To arrive at a satisfactory result for any given forest a large number of observations must be taken.

29th April.—March from Koti-Kanásar to Konain ; the path leads through the village lands of Mangtar and Tiuni, and we observed several trees lopped for various purposes, the oaks and *Celtis* for fodder, deodar for litter and manure. The three zones of vegetation were well observed on the hill opposite, spruce and silver at the top on Kanjatra and Kophti ridge, then deodar with its associates blue pine and moru oak, and lower down chir pine with some ban oak. At the bottom of the valley we crossed the Binalgadh and found *Cæsalpinia sepiaria*, *Albizzia Julibrissin*, *Pistacia integerrima*, *Rhamnus persica*, *Rhus semialata* and *Olea cuspidata*. From the Binalgadh to Konain is a stiff climb of some 3,500 feet up a bare hill side.

1st and 2nd May. The monthly oral examinations in Forestry were held on these dates.

We inspected compartment 4, Konain, in which improvement fellings were made last year, the trees being marked by the students in 1891, as follows :—

Species.	Under 1 foot diameter	1-2 feet diameter	2-3 feet diameter	Over 3 feet diameter	Total.	Remarks.
Deodar	1	...	...	...	1	Head broken badly.
Kail	8	6	3	...	17	
Rai and Morinda ...	76	86	49	3	214	
Other species ...	3	3	...	...	5	Chiefly birch.
Total ...	88	94	52	3	237	

The slope is steep (40°) and the aspect N. E.; the crop consists of spruce and deodar, with blue pine, birch, moru oak, and a little silver fir.

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The slope is steep (40°) and the aspect N. E.; the crop consists of spruce and deodar, with blue pine, birch, moru oak, and a little silver fir.

The object of the improvement fellings in this forest is as follows :—

(1) to give more space to the crowns of deodar poles and trees by the removal of inferior species, generally spruce, which are crowding them up.

(2) to free deodar small poles and the larger saplings (especially if in groups) by the removal of overtopping spruce and silver fir.

(3) to give more room to fertile deodar seed bearers to enable them to bear seed.

These are the principal objects ; and in cases where we come across groups of young saplings of fir, we may give them more room by removing one or two mature firs around them. All the material can be utilized as fuel, owing to the new road to Chakrata, *viâ* Pandawa.

We marked trees in this compartment as under :—

Kind of tree.	Under 3' girth.	3'—6'	9'—9'	Above 9.	Total.	Remarks.
Blue pine ...	48	21	17	0	86	
Firs ...	30	31	27	12	100	
Deodar ...	1	1	0	0	2	Broken tops.
Miscellaneous ...	1	3	3	1	8	
Dead trees ...	3	10	4	1	18	More dead trees were marked than the No. given here.
Total ...	83	66	51	14	24	

Fire conservancy was introduced here in 1872, and before that, fire must have been severe, as the charred remains of many old trees and the large scars on the upper sides of many standing deodars testify. The Konain forest has been heavily worked in past years for building material for Chakrata, and the supply of green and dry timber to the villagers ; but in spite of these heavy demands, the forest has a grand future before it, as it is well stocked, and consists for the most part of deodar ; there are some splendid deodar thickets with complete canopy.

We examined deodar plantation No. 2 of 1876, in Compartment 4. The place is well drained and sheltered, soil good, aspect N. E. The planting was done close, 5 feet by 5 feet, and the lower

branches are now dead. As an exercise, we pruned off the dead branches up to two feet from the ground. The seeds were sown in the Tika nursery in 1872, pricked out into nursery lines in 1874, and put out in 1876, in pits 5 feet by 5 feet. Measurements made are as follows :—

1885	average height	50	plants	5 ft.	9 in.
1893	"	573	"	13 "	4 "

Some of the original plants which have been allowed to grow on in the Tika nursery are now about 15 feet high. The spot chosen is perhaps too flat for deodar and not sufficiently drained, as these plants do not compare favourably with a similar case in Bodyar (*vide* page 287.)

We examined some instances of plot sowing near the nursery; the plots are 10 feet by 10 feet scattered about among *Indigofera* and other shrubs, and contain from 6 to 10 plants each, probably 15 years old, the length of the annual shoot being 13 inches.

Another instance of plot sowing is to be found in the Chaulu 'that,' Siari block, where in 1875 a clear felling was made over an area about 600 yards long and 300 yards wide. The aspect of this place is N. E, and the gradient about 25°. A few moru and spruce were left as seed bearers, and immediately under the former, some seedlings of moru may be found; but otherwise the area was over-grown with willows, poplars, brambles, *Strobilanthes*, and other shrubs, and the reproduction by seed was *nil*. Hence in 1881, plots 5 feet by 5 feet were sown with deodar seed, 500 seeds to a plot; superfluous plants which came up were used in filling up blanks. We counted 43 plots and found 764 plants, giving us an average of 18 plants in one plot with an average height of 6 feet; it would be advisable to thin out these plants leaving 2 or 3 of the dominant ones in each plot. This area is interesting as demonstrating how important it is to *avoid* making anything in the nature of a clear felling in these hills.

The Gidhi Khud Coppice of Karshu Oak.

This coppice forms a portion of the Hajawa Forest and is included in a working circle with two detached areas of Karshu as follows :—

Gidhi Khud	12	compts.	38	acres.
Hajawa	4	"	12	"
Jadi	4	"	12	"
Total	20	"	62	"

From the above it will appear that the rotation of the coppice is 20 years, and the average size of the annual coupe 3·1 acres. The elevation of Gidhi Khud is over 9,000 feet and growth at this height is not very rapid; hence it remains to be proved whether a rotation of 20 years is sufficiently long to yield fair sized fuel.

Alternate compartments are worked in succession, so that the intermediate compartments may afford protection against wind,

frost, &c. and a shelter belt has been preserved along the top of the ridge. Snow is to be feared at this elevation, and we noticed the effects of the late severe winter in the breaking off of the young coppice shoots with the bark of the stool attached.

The standards have been well chosen and are uniformly distributed, with straight stems, and fairly broad, symmetrical crowns which will now expand owing to more room.

Felling, cutting and stacking are done by contract at Rs. 2 per 100 st. c. ft., the contractor being bound to cut below 6 inches from the ground; the stools are afterwards dressed by daily labour. Only stools of a foot in diameter or less are dressed. The experiment of ringing stools of large trees, instead of dressing them, has been found unsuccessful and therefore abandoned.

It does not pay to carry the small branch wood to Chakrata, and anything under 2 inches diameter is left on the ground. In some places these branches are lying on the coupe in deep masses, not only injuring the shoots, and preventing their growing up, but also preventing the germination of any seed that may be shed. In all our Indian coppices, at some distance from the market, this disposal of the branch wood is a matter of serious difficulty, and merits more attention. Fortunately, in a damp climate, the material soon rots, but not before it has had time to injure the stools.

It is important to notice that the compartments above the road are being worked first, and then will follow those below the road, so that no damage will be done to coppice shoots by logs, trees, &c., falling down on to them from above.

The following table shows the yield of the compartments already cut over :—

No. of Compt.	Date of cutting.	Area in acres.	No. of standards left.	Outturn in stacked c. ft.	Outturn per acre st. c. ft.	Average length of last year's shoot.	REMARKS.
2	Nov. 1889	2·5	30	9,700	3,880	4″	
4	Nov. 1890	2·75	50	11,640	4,234	10″	
6	Nov. 1891	4·5	65	11,985	2,663	8″	
3	Nov. 1892	2	50	*5,500	*2,750		*Estimated.

The trees which are being felled now are clearly very much older than 20 years, and it is certain that the yield at the beginning of the next rotation, will fall far short of the present yield which averages up to date 3,382 st. c. ft. per acre. Karshu acorns have been dibbled in some of the compartments already worked over, and have come up successfully. There are so many old stools which produce no shoots that it is obvious something of this kind must be done.

(*To be continued.*)

Forest Administration in the Central Provinces.

In the last October number of the *Indian Forester* there appeared an article setting forth roughly the "present forest administration of the C. P." ; and making certain remarks with reference to "impending legislation." This article was written at a time when the Local Government had fully convinced itself that some alteration had to be made in the present administration ; and, taking up its stand on the hardships of the agriculturists, and the "Zulum"—to use a well-known Anglo-Indian term—of the Department, it was ready to clutch at any straw, provided it could say that something had been done.

Under these circumstances, there was a fear—a great fear—that the popular cry of the uninitiated for "Commutation" should be accepted. But, as was pointed out on page 418 of the *Indian Forester* for November, 1892, this proposal "which would surely have been a step backwards instead of one of progress" was repeated by the Chief Commissioner.

Since that time much has happened. The reign of Morpheus has truly passed ; and we are now in the midst of the greatest revolution the forest administration of this or any other Province has ever witnessed. In one half of the Province only—to quote the words of those in authority—"over 1550 square miles of forests will thus shortly be provided with working plans" ; actual compilation of the plans being completed by about this time next year.

With reference to the introduction of this scheme I have recently had an opportunity of perusing a most interesting note relating solely—as far as statistics are concerned—to the forest area of the Northern Circle ; though, as far as the scheme is concerned, it is to be applied without modification both in the the Northern and Southern Circles. I had hoped, before this, to have read an account of this revolutionary undertaking in this Magazine : but as nothing has yet appeared, the following notes which I have been able to collect, may be of interest to the readers of the 'Forester.'

I will begin by giving a few statistics, relating only to the Southern Circle, which will aid materially in arriving at an understanding of the scheme ; after which, a short account of the scheme itself will follow.

As a preliminary, it may be of interest to note that the half of the Province forming the Northern Circle, occupies an area of 10,079 square miles, including forest land and cultivation ; and this country is inhabited by a population of 3,476,595 souls, as returned at the last census. Now, the area of the Malguzari and Zemindari or Proprietary Forests, situated in this tract, is given as 11,014 square miles ; so that, supposing the inhabitants to be solely dependent on the private resources of the Province for their forest requirements, it would follow that 1·4 acres per head of population would be available.

Dr. Schlich in his book on Forestry, has stated that for a nation 1 acre per head of population is a sufficient area of forest to meet the requirements of the people. Consequently it would appear that the people are independent of Government Forests. There is reason to believe, however, that the above figures do not in reality express the wooded private areas—that is to say, that in the above figures the word forest must be taken in its very general and widest signification; and not in the sense, of "woods." And as will be seen from figures given below, there is a decided demand on the Government forests.

Let us turn now to the Government Forests. The total area is given at 10,079 squares miles, which is made up as follows :—

Fire—protected and closed forests	2,822 sq., miles
Area to be excised from Govt., forests	2,249 ,,
Open forests	5,008 ,,
Total	10,079 sq., miles.

Deducting the area which is shortly to be excised, it follows that 7,830 square miles is the area of Government forests which will be permanently retained by the Forest Department of these Provinces.

Of this 2,822 square miles is the area of Closed forests * and the remainder 5,008 square miles, constituting the open forests, in the area to which the scheme to be described is to be applied.

This area of 5,008 square miles is not, however, wholly wooded and it is estimated that 45% of the total area consists of blanks. From which the following is deduced :—

Area of open forests	5,008 sq., miles
Deduct area of blanks	2,253 ,,
Wooded area	2,755 square miles.

Now, in this area of 2,755 square miles, I gather that 4 valuation Surveys by cutting over a total area of 195·5 acres, were carried out with the following results per acre, after leaving 30 standards :—

Produce.	Valuation Survey.			
	I	II	III	IV
	in tons	in tons	in tons	in tons
(a) Timber	2	1	6	47
(b) Fuel	7	6·24		
Total	9	7·24	6	47

* For definition of "Closed" and "Open" forests, *vide* pages 375 *Indian Forester* for October, 1892.

These results would give an average of 6·7 tons of wood to the acre.

And, therefore, for the purpose of Working Plans, the following average is accepted, after leaving 30 reserves to the acres :—

(a) Timber	...	... 1 ton
(b) Fuel	...	... 4 tons
	Total per acre	5 tons

Accepting this average yield as correct, we arive at the result that on the 2,755 square miles forming the wooded portion of the "Open Forests" the following is the stocking :—

(a) Timber	...	... 1,763,200 tons
(b) Firewood	...	... 7,052,800 „
	Total	8,816,000 tons

Now, as to the consumption from these forests, as calculated by the registered sales of the previous year 1891-92, the following is the result :—

(a) Timber	...	... 11,352 tons
(b) Firewood	...	... 47,816 „
	Total	59,168 tons

Or, reducing this to acres, at 5 tons to the acre, we have that the area to be cut over yearly to meet the demands is equal to 11,834 acres, as compared with 1,763,200 acres of well stocked forest available.

Having said so much by way of preface, it is now time that we turned our attention to the details of the scheme itself. Roughly speaking, it may be stated that the usual practice in preparing Working Plans is to start with a forest—that is with a tract of wooded country of given area; then to divide this area into blocks and compartments; then to fix the rotation; then to determine the yield per acre, and finally to fix the annual cuttings. In the Central Provinces, however, this procedure is to be completely reversed. Above, we have shown that the consumption from the forests of the Northern Circle during the year 1891-92, was equal to 59,168 tons, this quantity being the registered consumption during the year 1891-92, for the whole of the Northern Circle, which is divided into 8 Forest Divisions; these again being divided into so many Ranges. So that the consumption from the Government Forests of each Division, and of each Range is known. Further, in each Range there are a number of licensed vendors whose duty it has been to sell licenses at fixed rates per cartload or headload to the people requiring forest produce, the purchasers being permitted to cut and remove the same from any part of the forest served by a particular license vendor. It follows that not only is the total sale of forest produce per annum from each license vending station known, but also the quantity of produce removed from the heart of Government forest land, for the

extraction of produce from which licenses were sold at a fixed license vending station.

Now, this knowledge may be called the foundation stone of our scheme ; for, not only does it aid materially in determining the number of working circles which are to be established in any Range, the working circle being so fixed and in such number that no inconvenience is to be caused to the people in carying produce removed from the annual cuttings, for long distances to their homes ; but this knowledge is indispensable for determining the size or area of annual cuttings, and of working circles, in a manner which will now be described.

For the purpose of introducing this new scheme the first thing to be done is to determine the annual yield which is required from a particular tract of forest—that is to determine the consumption in tons during the year 1891-92 from this tract. This information in cartloads and headloads, is obtained in the manner just explained from the license vendor, who has been selling licenses for that particular tract ; and on the assumption that 1 ton=3·3 cartloads=36 headloads, the tonnage follows.

The yield which the annual cuttings of the working circle, which it is proposed to establish in a part of a Range, that is, the registered quantity yearly consumed in the tract having thus been fixed, it has been thought expedient to add to it 50% "to meet the 'more than probable increasing demands which are certain to be 'made on the forests if the selling rates are lowered." And now by dividing the resultant figure by 5—(*i.e.* 5 tons, the average stocking of the open forests of the C.P., as above explained)—the number of acres of wood which require to be felled to yield the estimated out-turn is determined.

The next and final step, the fixing of the working circle, is quite as simple. It has been shown above that "45 per cent of the total area of the open forests consists of blanks" consequently as the rotation is fixed at 30 years for the following reasons, namely, "that the coppicing faculty of the several species to be dealt with is 'not lost but is well maintained within that age even extending up 'to and beyond 50 years in most species. Teak coppices fairly well 'up to 50 years ; so do sal, lendhya, mohwa, sirioa and numerous 'others which yield valuable timber and other products" ; the idea being to produce poles from 9 to 12 inches and up to 18 inches girth, such poles "being in greatest demand by the people, as 'with them they build their houses, fence their fields, and 'employ them as supports for sugar-cane crops"—it follows that by multiplying the number of acres thus found by 54·54, (*i.e*, $1 \times \cdot 818 \times 30 = 54\cdot54$), the area of the required working circle will be derived.

The following example will, perhaps, best illustrate the method :—

Suppose that the registered consumption of wood for the locality in the years 1891-92 was 10 tons, 50 per cent added would

raise this to 15 tons. The required area of forest expected to yield 15 tons or the average rate of 5 tons per acre will be 3 acres, then 3 multiplied by 54·54=163·62 acres will be the area of the Working Circle.

The area of the required Working Circle having thus been fixed, theoretically, it is in the next place to be laid down, practically, on the ground—a portion of forest of the required area of the Working Circle being carved out from the existing forest area. This being done it only remains now to say a few words with reference to the method of treatment and the method of conducting the fellings. From what has already been said it will have been gathered that the "method of treatment" or sylvicultural system is to be that of coppice with standards, the number of standards being fixed at 60 to the acre, besides all trees having a circumference area of 3 feet. The rotation, for reasons above given, is fixed at 30 years.

As to the method of conducting the fellings, the period of 30 years is to be divided into 2 periods of 15 years and the fellings will be conducted on the method of strips, 5 chains broad, and not more than 20 chains in length, the trees on every alternate strip being left standing, each strip and alternate belt of trees thus being of equal width occupying equal areas. That is to say that perfect parallellograms 5 chains broad, 10 to 20 chains long, are to be laid down on the ground, and cut alternately. The entire area of the Working Circle will thus be gone over during the first 15 years, and in the 16th year the fellings will recommence, the alternate belts being then felled—and so on to the 30th year.

In conclusion it is only necessary to say a few words with reference to the effects of this new scheme in upsetting the old system of management. In the old days the person requiring a forest produce had merely to purchase a license at the nearest license vending station and armed with his license and his axe he had the run of the whole forest wherein to satisfy his desires. There was practically no check and certainly no system.

By the introduction of the new scheme above described all the Government forests will be closed and reserved, with the exception of the annual cuttings, that is the strips which are to be annually felled and from which alone green wood is to be obtainable: the license vendor residing on the site of the cutting area, in order that no great inconvenience be caused to the people dependent on the Government forests, their produce for the annual fellings are to be fairly close together; and in fact the number of working circles which have been established in the different Forests Divisions would appear to vary from 30 to over 60. For these, working plans are to be prepared at once, and in the words already used above, over "1,550 square miles of forest will thus 'shortly be provided with Working Plans"; "the actual compilation

of Plans being completed by about October 1893. Thus we have to contemplate the following mysteries. To begin with, a Province, which has an area of Government Forest equal to x acres which have been worked for over 30 years without even the elements of a Working Plan being thought necessary; though a consumption of about y tons has been the average yearly quantity of material removed from these forests, the whole of this produce having been extracted at the will and pleasure of the purchaser from any part of a Government Forest without let or hindrance: suddenly, in a single year, from the Government forests of this Province not a single stick will be removed except in accordance with the provisions of a Working Plan.

In this article, only a rough description of the scheme which is now, it is understood, in working order, has been given. Details have been omitted, as being, perhaps, tedious and unnecessary to the understanding of the scheme itself. Similarly, all criticisms of the scheme have been avoided: though both these matters might well form the subjects of special articles.

TUSCAN.

Forest Conservancy in the Catchment areas of tanks.

An interesting discussion has lately taken place on the advantages and disadvantages, from the point of view of water supply, of fostering woody and herbaceous growth in the drainage area of the Danta tank in Ajmere, where the climate is dry, evaporation great, and the rainfall slight and uncertain in its character. It has been found impossible, in this case, to arrive at fairly reliable conclusions ; but the general question does not appear, in India at least, to have ever been systematically investigated. Should any of our readers have had special opportunities for observing how forest conservancy in such a climate affects, in loose dry soils, the retention of water on sloping ground, the record of their views in this journal would no doubt be of advantage in elucidating the question.

The tank alluded to was completed in 1878. It is situated among low steeply-sloping hills in a very dry climate, the average annual rainfall being about 16 inches. The drainage area extends over about 3 square miles, the whole being a rocky basin, covered thinly with a light sandy soil. The vegetation, when protected, is of the poorest kind—low stunted trees or shrubs, with grass, much of which disappears in seasons of drought. The forest growth in the catchment area was first conserved in 1880, and has since been uninterruptedly protected. Conservancy was undertaken because

it was confidently expected that, not only by this means would the silting-up of the tank-bed be impeded, but, more especially, that the brushwood and grass would enable a greater percentage of the total rainfall to reach the reservoir, by diminishing evaporation and by causing water to flow off the slopes less rapidly and to continue flowing for some time after the cessation of rain. The assuring of a slow and continuous flow, provided that the total in-take of water in the tank is not thereby much reduced, would be, in this case, of special importance, as evaporation from the tank surface is probably greater than when the water is flowing towards the reservoir. In 1892, however, after 12 years of forest conservancy, it was reported that the tank had dried up, and it was proposed to permit thenceforward unrestricted grazing and the cutting of bushes during the greater part of each year in the area drained by the tank. It was argued that the effect of forest conservancy was, by retarding the flow into the tank, to increase the loss by evaporation. This argument was founded mainly on the accepted fact that, in previous years, the tank had only been filled after very heavy rainfall. No proof was adduced that the in-take of water would have been greater had the vegetation not been protected ; but it was roundly stated that the drainage area would be best adapted to its requirements were the whole surface covered with a smooth impermeable substance, such as asphalt. Before coming to a conclusion, the local authorities undertook a further enquiry as to the circumstances of the reservoir, and the effect which the presence or absence of forest growth has on the quantity of water actually becoming available in that and other local tanks similarly situated. The result of this enquiry is that *data* are not available on which the matter can be set at rest. The various officials consulted are fairly evenly divided in opinion : some considering, for instance, that, when the rainfall is slight, the water has a better chance of ultimately reaching the tank if the vegetation on the hill slopes is protected ; others condemning forest conservancy as an unmixed evil from the point of view concerned. The course finally adopted has been to defer the settlement of the question for a short term of years, during which the quantity and character of the rainfall and other particulars will be systematically observed and recorded. Although the discussion has been hitherto to a great extent based on academic considerations, it has raised an interesting question which, in some localities, must be of considerable economic importance. There are many localities in Southern India which must be very similar to that in Ajmere, where tanks surrounded by hills which have been taken up as Reserves might be expected to give information. Most especially are such localities common in the Ceded Districts and we hope some of our readers in those Districts will give us their experience. And as regards the Danta tank, the results of the experiments to be undertaken will influence the solution of similar problems in various parts of India.

Charcoal for Iron Smelting.

In the annual report of the Geological Survey of India for 1892 it is stated with reference to the iron-ores of Southern India that the question of the successful development of the enormous iron-ore deposits of the Salem District becomes eventually a forest problem, as there is no coal in the district and no immediate prospect of profitably using for this purpose, on account of heavy transit charges, the coal raised in other Provinces. It may be urged that it by no means follows that because an iron industry cannot be developed owing to the costliness of coal, charcoal can therefore be made available at a sufficiently low-cost to float the industry. But it certainly behoves the Forest Department to put forward such a report of its resources, and possibilities, as will distinctly show to what extent, both as regards material and as regards cost, it can contribute towards the utilization of the ore.

In view to this, the first information required seems to be a reliable statement of the quantity of charcoal required to produce a ton of iron. Such authorities as Sir Dietrich Brandis and Dr. Schlich pronounced this to be $2\frac{1}{2}$ to $3\frac{1}{2}$ tons, and their statements, have so far as we know, remained unquestioned, up to the appearance of a letter in the *Pioneer* by Mr. Charles McMinn, dated 20th March last, in which it is said :—"In the Blandfer furnace, writes 'Greenwood, page 134, the consumption of charcoal is $16\frac{3}{4}$ cwt. per 'ton of pig produced." The actual experience of our readers is earnestly sought in order to reconcile these different authorities, Our limited acquaintance with the subject of iron smelting goes to show that in a rule of thumb sort of measure equal quantities by weight of ore and charcoal are used, and that it is more likely that $16\frac{3}{4}$ cwt. of charcoal are consumed in a Blandfer furnace to smelt a ton of ore, than to produce a ton of iron.

Then comes the question of the yield of the ores. In Watt's Economic Dictionary, we find that Salem magnetite containing 17 per cent. of metal yields by the methods in vogue only 15 per cent. Can 50 per cent. be obtained from the richest ores with an expenditure of charcoal of two tons to one ton of iron produced ? Or can better or worse results only be obtained?

With further reference to Mr. McMinn's letter above quoted and which is reproduced below* it may be safely asserted that the constituents of wood absolutely dispose of the matter of obtaining by any process of carbonisation more than 25 per cent. of the wood by weight in charcoal. The usual result, under favourable conditions, is 21 or 22 per cent. of charcoal.

Finally, it may be said that the yield of forests so differently situated as those of Madras and Russia can scarcely be compared. Full complete forests in Europe may produce a ton per acre per annum, and we have forests in India which produce that amount,

such as our richest and best stocked Sal forests of the Himalayan Terai, but whether the forests of Salem or the Boswellia mixed forests of Central India actually produce one-half or one-tenth that amount of wood is for our readers in those localities to show, and we trust they will come forward and clear up this point.

The charge made against the department in regard to its *cherished wood* may be dismissed with the remark that the department is ever ready to find an outlet for its products at a profitable rate. If Metallurgy or any other industry can offer value for wood either at present existing, or to be grown in the future, the financial and commercial abilities of the Forest Department which have always been rated highly, will not fail to meet such an offer in a liberal and business-like way.

H.

*IRON MANUFACTURE IN INDIA.

To the Editor.

Sir—From the threepenny handbook of commercial products, No. 8, Iron, published by the Government of India, I learn that Government officials seem to be labouring under erroneous ideas touching the effects of iron working upon forests. We are told at page 14, apparently on the authority of Sir Dietrich Brandis, that 10,000 tons of iron require 35,000 tons of charcoal, to be produced from 140,000 tons of wood, which, at the rate of half a ton per acre of annual yield, require 280,000 acres of forest. During a long career of respectful criticism of official literature, I have ever submitted that Indian officials will make grave mistakes and fall into perilous delusions if they refuse to peruse and digest the non-official literature of their subjects. Now we can understand from these figures why the Indian Forest Department has, though graciously disposed, still hung back when asked to make concessions for iron manufacture. Twenty-eight acres of forest for each ton of pig! So far as I can judge from the authorities within reach, each one of these three statements largely underestimates the productive power of each several factor. We are told that an acre of forest only produces half a ton of fuel annually, that eight acres will be required for one ton of charcoal, and three and a half tons of charcoal, or twenty-eight acres, for one ton of iron. The best authority on the subject, Jeans, states that each blast furnace requires at least 20,000 acres of forest for fuel in Russia—see page 262—and every modern blast furnace turns out 10,000 tons per annum as a minimum. In the Blandfer furnace, writes Greenwood, page 134, the consumption of charcoal is $16\frac{3}{4}$ cwt. per ton of pig produced. As for the half ton of wood per annum per acre, when root crops at home yield 10 to 50 tons, I am silent. Dr. Schlich—see article Charcoal, Watt's Economic Dictionary—though himself a forester anxious for his charge, estimates the charcoal required per ton of iron at $2\frac{1}{2}$ not $3\frac{1}{2}$ tons. At any rate, if 20,000 acres of forest suffice in Russia and India, where reproduction is far more rapid, a much smaller area should be ample. Years ago, I pointed out in your columns that the best Jabalpur iron was made with bamboo and Boswellia, which were waste products over vast areas of our forests. I submit that the statistics circulated by Government in the threepenny handbook are calculated to discourage Indian metallurgy, though probably the intention of its author was quite the reverse. Of course the Forest Department will be hostile when told that 280,000 acres of their cherished wood are wanted for each blast furnace; they would be friendly, probably, if informed that 10,000 acres was, at any rate, much nearer a sober estimate.

CHARLES W. McMINN.

The Charduar Rubber Plantations in Assam.

We have received from the Government of India a copy of a report on the Charduar rubber plantation which had been called for by them in their review of the Assam Forest Administration Report for 1891-92. We quote the following extracts from it.

"The plantation which was commenced in 1873, had up to '*February 1884 report*, been successfully carried out over 892 'acres at a cost of Rs. 64,351' or Rs. 72, per acre. The ques-'tion then arose whether the undertaking should be continued or 'whether it would not be better to stop further extension.

'Mr. Mann considered he could prove the work to be financi-'ally a paying one, and recommended a yearly extension of 200 'acres. He estimated that a rubber tree became mature for tap-'ping purposes at the age of 50 years, that 5 seers of rubber could 'be obtained from such trees for 16 successive years, and that 10 'such trees would stand on an acre of planted land. That each 'tree, therefore, would yield 2 maunds, and each acre 20 maunds 'of rubber worth Rs. 54 per maund, or Rs. 1,080 per acre, as 'against an expenditure of Rs. 72 per acre for formation and 'up-keep. Even had this latter sum been increased by com-'pound interest at 4 per cent. which would have brought the 'original outlay up to about Rs. 511 per acre at the end of 50 'years, there would still remain a large margin for profit accord-'ing to the above estimate.

'The Chief Commissioner, Mr. (now Sir Charles) Elliott, did 'not take the same high view of the financial prospects of the 'plantation, and was of opinion that, except for the purpose of 'carrying out further experiments, no extension should be made. 'He considered the Forest Department had proved how the rubber 'tree could be most successfully propagated, and was of opinion 'that the further development of the industry should be left to 'private enterprise.

'The Government of India reviewed the whole question, 'and eventually decided that, as the financial prospect appeared 'favourable, as there was no immediate prospect of private capital 'being invested in the industry, and as there was every probability 'of the rubber supply being gradually exhausted, it would be wise 'to extend the plantation by 200 acres per annum. It was also

'ordered that certain tapping experiments should be carried out 'with the view of testing further the probable financial results, and 'that the planting of *Ficus elastica* as an epiphyte on other trees 'should be undertaken on a larger scale than heretofore.

'Work was, therefore, continued, although not on the scale of '200 acres a year, owing to financial pressure. An attempt to 'establish the plant as an epiphyte on about 50 acres was unsuccess-'ful, and in 1889, when the Inspector General of Forests visited 'the province, the plantation contained 1,043 acres of established 'trees, which had cost Rs. 85,582, or Rs. 82 per acre.

'In the report which followed the Inspector General's inspec-'tion of the Assam forests, it was again recommended that this 'annual extension of 200 acres should be proceeded with, which 'was accordingly done, with the result that at the close of the 'past financial year, *1892-93*, the planted area has increased to '1,900 acres, and the expenditure to Rs. 1,23,700, or Rs.65 per 'acre.

'Work has been performed much cheaper of late years than 'formerly, which naturally is due to the experience gained by past 'failures, some of which were of an expensive nature. During the 'six years between 1887 and 1893, I find that keeping up the old 'plantation and putting out 860 acres of new extension (of which 'a large proportion has been planted a second time owing to 'failures) cost Rs. 41,871, divided over the two heads as follows:—

	Rs.	Rs.
'New work	37,289	41,871,
'Up-keep	4,582	

'I find also that, with six years' efficient protection, the plan-'*tation is rendered tolerably safe against everything but illicit* 'tapping, the trees planted out in 1886-87 (compartment 13) being 'now safely established

' We may estimate, therefore, from the above six years' expen-'diture, that future work may be carried out and permanently 'established for about Rs. 50 per acre, exclusive of controlling 'expenses, as follows :—

$$\text{New work} \quad .. \quad \frac{\text{Rs.}}{\text{Acres}}\ \ \frac{37{,}289}{860} = \text{Rs. } 43{\cdot}36 \text{ per acre.}$$

$$\text{Up-keep} \quad ... \quad \frac{\text{Rs.}}{\text{Acres}}\ \ \frac{4{,}682}{860} = \text{Rs. } 5{\cdot}32 \quad ,,$$

Rs. 48·68 ,,

Say Rs. 50 ,,

'It is now to be decided whether it will be financially expe-'dient to continue the operation at the above cost, but the data

'available for the proper discussion of this point are unfortunately 'still very meagre, although we have a little more information on 'one important factor of the calculation than Mr. Mann had when 'he wrote his report in 1884.

'The three chief points on which information is required 'are :—

'(1) Age of exploitable trees.

'(2) Number of productive trees obtainable to the acre.

'(3) Outturn of rubber per tree.

'With regard to the first point, I am inclined to accept Mr. 'Mann's tree of 50 years as a mature rubber-yielding tree. The 'oldest portion of the Charduar plantation was put out in 1873-74, 'or 20 years ago, but the records prove that all the first compart-'ments failed time after time, and were not really successfully 'planted until 1877-78, or even later. It is not likely, therefore, 'that the trees in the oldest portion are more than 15 or 16 years 'old. And yet they now average about 50 feet in height and 6 'feet in girth. Such trees may, I think, fairly be expected to 'become productive in 30 more years or less.

'The second point, regarding the number of trees likely to 'stand on an acre, is a doubtful one. Mr. Mann relied on obtain-'ing 10 productive trees, and of course there would be no diffi-'culty in obtaining this number in the plantation. But I feel a 'little doubtful that if 10 trees per acre are allowed to remain, they 'would ever attain the dimensions of the trees growing in the 'natural forests, or yield as much rubber as is obtained from 'those trees. For it has been found from measuring the lateral 'spread of 50 forest trees (see statement attached to this report) 'that such trees possess crowns 94 feet in diameter covering, on 'the average, 980 square yards of ground. Now our trees, until 'recently, have been planted out 100 feet × 25 feet and are so 'crowded in the lines that it seems necessary to remove half of 'them in order to give the remainder more room for development. 'But, if half of them were removed, there would remain only 'between 7 and 8 trees per acre, and these trees would have only 'about 550 square yards of ground each, as compared with above '980 square yards covered by the forest trees.

'This year a different system of planting has been introduced, 'the trees being put out 70 × 35 feet apart. Eventually, if half 'of these be thinned out, there will remain about 9 trees per acre, 'each covering 544 square yards of ground. Practically, however, 'we do not yet know what the future condition of the plantation 'will be, or by what method, if any, thinnings should be carried 'out in the present standing crop ; and it is difficult, therefore, to 'anticipate the number of trees of 50 years old that will be left 'standing on an acre. But, for the purposes of this calculation, I 'will assume that 8 such trees may be relied on.

'Then in regard to the third point, having reference to the 'outturn in rubber obtainable from a mature tree, Mr. Mann, in 'his above-quoted report, calculated that a tree would yield 'an annual outturn of 5 seers of rubber for 16 successive years, or 'a total outturn of two maunds. His calculation was based on 'certain tapping experiments that had been carried out on 50 'forest trees in 1882-83 and recorded as an Appendix to the report 'for that year. These experiments were carried out very care-'fully under the supervision of the divisional officer for six years. '*The trees were selected as not having been tapped before, or as* 'having recovered from former tappings. They were not tapped 'lower than 4 feet above ground, the branches were not tapped at 'all, and the main axis was tapped at intervals varying between 2 'and 4 feet apart. The first year's tapping, on which Mr. Mann 'based his calculation, yielded an outturn of 5·60 seers of rubber 'per tree. But, as will be seen on reference to the statement 'attached to this report, this yield rapidly declined, and the 'annual tapping of the trees soon caused considerable damage.

'In the	first	year the	yield was	5·60	seers per tree.	
' ,,	second	,,	,,	1·06	,,	(bad season).
' ,,	*third*	,,	,,	*2.56*	,,	*(good season).*
' ,,	fourth	,,	,,	3·43	,,	(includes yield of 2 new trees).
' ,,	fifth	,,	,,	1.06	,,	(season good).
' ,,	sixth	,,	,,	·91	,,	(season good).
			'Average	2·43		

'Instead, therefore, of yielding 5 seers per annum as was 'anticipated, these trees, which had been most carefully tapped, 'yielded 2.43 seers during the six years they were worked. More-'over, out of the 50 trees originally selected, 6 deaths had '*occurred.*

'In 1884-85	...	...	1 tree died.
' ,, 1885-86	...	...	1 ,, ,,
' ,, 1886-87	...	...	2 trees ,,
' ,, 1887-88	...	...	2 ,, ,,

'*And it is fair to suppose that, if tapping had been continued,* 'all of these trees would have died in the course of a few more 'years.

'So far, therefore, as the experiment goes, it certainly tends 'to prove that no large yield can be obtained from ordinary single 'trees, and that even moderate tappings, if carried out annually, 'soon destroy the tree. Mr. Mann's calculation of outturn must, 'I think, be looked on as much over-estimated. One has heard, 'it is true, of trees said to have yielded a maund of rubber in one 'season's tapping, but the information is not exact, and the results 'of the above experiment seem to forbid any such expectaion. We '*seem to be nearly as far as ever from finding out what the real* 'outturn of a mature tree may be.

'It appears to me, however, that the chief mistake made was 'in thinking that the trees could be tapped year after year without 'the outturn becoming reduced in quantity. The mere fact of 'taking 5 seers of rubber from a mature tree would probably not 'injure this latter, provided a sufficient rest were given for recuper-'ation, and it might then be possible to extract a further similar 'quantity without permanent injury to the tree.

'This period of rest, I believe, should be not less than 5 years, 'which time is required, I am informed, for the tapping scars to 'heal over. It then, might be, I think, possible (judging from the 'experimental tapping results) to obtain another yield of 5 seers. 'But how long this process of yield and rest would continue, must 'at present be quite hypothetical. For the purpose of this report, 'however, it is necessary to assume certain figures. Therefore, let 'us suppose that a tree 50 years old is capable of yielding 5 seers 'of rubber once in every 5 years, between the age of 50 and 100 'years, or a total yield of 55 seers. Let us also suppose that 8 of 'such trees will stand on 1 acre of planted land, and that to establish '1 acre of such trees will cost Rs. 50. We may also, with much 'certainty, assume that a net profit of Rs. 50 per maund will be 'obtainable on the rubber outturn.

'The initial outlay of Rs. 50 will have accumulated to about 'Rs. 350 at the the end of 50 years, allowing compound interest 'at 4 per cent., and against this expenditure all that we could hope 'to realise would be Rs. 50 every fifth year, or the outturn 'of 8 trees = 40 seers of rubber, valued at Rs. 50 per maund. 'This amount of Rs. 50 would not equal the initial outlay for the 'five years' period of rest calculated at 4 per cent., which, on Rs. '300, would be Rs. 65. It is evident, therefore, that no matter how 'long the tapping process could be continued, there would result 'an ever increasing debt against the plantation. Judged on purely 'financial grounds, the further extension of this operation is not 'likely to be remunerative.

'The Government of India may, however, think that, in view 'of the nearly certain exhaustion of the natural rubber forests 'within the next 20 or 30 years, we should be justified in forming 'artificial forests for the purpose of keeping up a supply of a very 'valuable and useful product, provided the actual outlay incurred 'on its production were certain to be recouped. According to the 'above figures this recovery of actual outlay, irrespective of 'interest, would be realised from the first tapping at the end of '50 years, after which the plantation might be expected to pay at 'the rate of Rs. 50 per acre every fifth year for the next 50 years. 'But, if this view of the case were taken, and it was desired to 'supply the market with as much plantation rubber as is now 'obtained from the natural forests, say 4,000 maunds per annum, 'it would be necessary to tap over 4,000 acres a year, and to have 'established a productive area equal to 20,000 acres.

'The Government of India in their instructions requested that 'the report should deal with the plantation from a technical as well 'as from a financial point of view. In this report I have confined 'myself almost entirely to the latter standpoint as being 'the more urgent, and because I freely confess that the future 'treatment of the plantation is as yet a puzzle to me. We have 'discovered how best to propagate the rubber tree, and can, I 'think, rely on being able to extend its cultivation successfully to 'any reasonable extent at a cost of Rs. 50 per acre, but we are at 'present doubtful regarding the best treatment for obtaining a final 'crop on the ground.

'Last season, with the view of thinning out the trees in the 'lines, we tried to tap every alternate tree to death, and carried the 'operation over the two first compartments. The tapping certainly 'looked sufficiently severe, the main axis and all main branches 'of the trees being tapped at short intervals. But I am informed 'by Mr. Copeland, the divisional officer, that the trees operated 'on, so far as their general appearance is concerned, are now 'not distinguishable from their untouched neighbours, and in this 'connection it may be interesting to note that at the last inspection 'of the Conservator it was discovered that the roots of the trees 'standing in the same lines and even in adjoining lines 25 feet 'apart showed a decided tendency to anastomoze, so that, when 'exposed, the root system appeared as a continuous net work.

'If the roots of these plantation trees have really become in'corporated in one system as suggested, it would perhaps explain 'why the tapped trees have suffered so little, because they have 'been sustained and nourished not only by their own channels of 'food supply, but also by those of their neighbours. On finding 'this out, the tapping operation was temporarily stopped; and, 'after consulting Mr. Gamble, of the Dehra Dun Imperial Forest 'School, it was decided for the present not to interfere with the 'apparently surplus trees, for it seems possible that a severe tapp'ing operation, carried out on such trees, might have, to some 'extent, an exhausting effect on the adjoining trees which it is 'desired to protect and develop.

'The plantation will be carefully watched, and the technical 'report called for will be furnished when more information is 'available.

'It may be noted that the yield in rubber from tapping the '1,116 trees in compartments 1 and 2 came to only 3 maunds and '8 seers, or 9 tolas per tree.

'In conclusion, I beg to report that 150 acres of new ex'tension having been prepared for planting at a cost of Rs. 1,800, 'I have authorised the Divisional Forest Officer to plant up this 'area at an additional cost of Rs. 2,000, and to suspend all further 'operations until orders are received from the Government of India.'

Statement showing results of tapping certain selected rubber trees in the Balipara plantation during the six years 1882-88.

Year.	Number of trees.	Total yield in rubber.	Average yield per tree.	Total net profit realised.	Total loss.	Net profit per tree.	Net loss per tree.	Remarks
		Seers.	Seers	Rs.	Rs.	Rs. a. p.	Rs. a. p.	
1882-83 ..	50	281	5·60	261	...	5 13 0	....	Season favourable.
1883-84 ..	50	53	1·06	....	15	....	0 4 9	Season very unfavourable owing to constant rain.
1884-85 ..	Old 48	123	2·56	138	....	2 9 0	...	1 tree died. Season favourable.
	New 6	76	12·66					
1885-86 ..	51	175	3·43	Not stated			....	1 more trees died Season favourable. Only 2 of the 6 new trees tapped.
1886-87 ..	48	51	1·06	Ditto			....	2 more trees died Season favourable. Only 2 of the 6 new trees tapped.
1887-88 ..	46	42	·91	Ditto			....	2 more trees died. Many trees reported to have yielded no rubbecr.

NOTE.—The lateral spread of these trees varied between 56 and 195 feet, the average diameter of crown being 94 feet.

These results seem to point to the necessity of a short rotation only for tapping. The experience of Bengal also seems to point to this, for we can remember, from having had personally to superientend much of the work, how the heavy tapping for 4 or 5 years in 1870 to 1875 in the Darjeeling Hills resulted in the death of the larger proportion of the trees and the weakening of the survivors to such an extent that when an attempt was made six years later to tap these again it was not successful. We stongly advise further experiments: one experimental area to be tapped for two years, then allowed two years rest and trees tapped again, and so on; another to be tapped every alternate year; another every year, but only slightly, and so on. The roots should on no account be tapped for they usually give only inferior rubber and their tapping is said to be the cause of the chief injury. What is often forgotten, we think, is, that the best yielding trees are not those grown on moist lands but those on comparatively dry slopes, and herein may possibly lie the reason for the apparent unsuccess of these fine plantations. But, given a suitable area, we confess to thinking that a little crowding may not do much harm: the object is presumably to get the maximum yield from the area and a somewhat crowded area would give more tapping surface. But we may be wrong, and it may be found that better rubber is got from branches and stems and droppers which have got full light around them, so that here, too, are questions which seem to demand further experiment.

The Question of the authority of altering Working Plans.

The following Circular was circulated a month or two ago among Conservators of Forests by the Inspector General. As it may possess considerable interest for those who have not seen it officially, we venture to reproduce it.

'Representations have recently been made by the Conservators 'of two Forest Circles to the effect that the provisions of the 'Forest Department Code and of many existing working-plans 'do not permit of sufficient latitude in the execution of prescribed 'works, more particularly works of improvement; and it has been 'suggested that the present practice and the rules contained in the 'Code should be modified. I had previously arrived independently 'at the same conclusion; but, before taking further action, will 'be obliged by your favouring me with your professional opinion 'on the general question raised.

'2. My own views may be briefly summarized as follows :—

'(i) Exploitation in deficit might be permitted on the order 'of the Conservator, who should however, subsequently report re- 'sults to his Local Government, and in cases where the deviation 'from the provision of the working-plan is considerable or con- 'tinuous, obtain the sanction of the Local Government thereto. 'Particulars of all such deviations should invariably be recorded in 'the control forms.

'(ii) The previous sanction of the Local Government should 'in every case be required, when it is proposed to exploit in excess '(provided such excess is not caused by the accumlation of balances 'due to deficit exploitation in previous years), or when it is con- 'templated to change in any way the character of the exploitation.

'(iii) The plan might *prescribe* that work—

(*a*) of sylvicultural improvement, or

'(*b*) connected with lines of communication and export '(the execution of which in any special year may depend so largely 'on circumstances we are unable to control or even to foresee) 'should be carried out during a certain period of years. Such 'works might be allotted in the plan to particular years, and 'such allotment should be binding on the local officers unless and 'until the Conservator had sanctioned the total or partial post- 'ponement of the work or other deviation, reasons for which he 'would invariably record in Form No. 3.

'(iv) As regards buildings, demarcation, and minor works 'of improvement, the general plan for a term of years might be '*prescribed*, deviations from which would require the sanction of 'the Local Government. But the manner in which the details o

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'the plan would be carried out from year to year might be solely 'controlled by the Conservator, who would record in Form No. 3 'whether suggestions made in the plan, under this head, for each 'year's working, had been carried out or not, and, if not, why not.

'(v) Form No. 3 should not be made use of as an account 'form for the check of all expenditure upon works of improvement, 'but should be a record containing information sufficient to indicate 'how such works of material importance, prescribed or suggested 'in the plan, have progressed.

'3. I would ask you to acquaint me with your views as early 'as you conveniently can."

Inspection Notes on the Forests of South Coimbatore, North Malabar, Nilgiris and Madura.

These notes, received by the kindness of the Madras Government, are rather more instructive as samples of administration than as affording sylvicultural and other information of interest to our readers. The *South Coimbatore* note is especially remarkable for the curious circumstance that the Conservator's remarks are largely annotated by the Divisional Forest Officer who here and there is pleased graciously to agree with his Superior Officer and in other places to differ from him. After wading through these remarks, however, we were comforted at the end by finding that the Board of Revenue most properly objected to the arrangement, and expressed themselves as considering it "invidi-'ous that the District Forest Officer should appear as a direct critic 'of the remarks of his Superior Officer, the Conservator." One would have thought that such an obvious proposition would have been as clear to the Collector and Divisional Officer as it was to the Board. The Conservator's note is full of the minutest details in some things: even such a trivial matter as the absence of 'hat pegs' in a Range Office has not escaped his vigilant eye, but while full of such details, there is an absence of forestry information. There are, however, some interesting matters regarding Forest Engineering, and especially on the—

"*Timber Slip.*—When I was last here in 1888, I considered 'with Mr. Porter the feasibility of a slip in place of the drag-road 'down which logs were moved by elephants in the old days.

'I considered the site then selected to be too steep and 'further inquiries were started with view to lowering the logs by 'wire or other means, but nothing satisfactory was arrived at.

'Mr. Bryant has, however, opened up a part of the old drag-'road, paved it with timber laid lengthways instead of crossways,

'and converted it into a slip, which I was so satisfied with, that I 'have authorized him to spend up to Rs. 500 in continuing the 'experiment.

'It is proposed to slide the logs from the top slip depôt (end 'of the tram line) to a bottom slip depôt, which touches the ghát 'road sufficiently far down to avoid all the most difficult parts of 'the ghát, and thereby save As. 7-6 a candy (12½ cubic feet) on 'the present rates for carriage, which are As. 15-6 per candy by 'road from the top slip depôt to the foot of the ghât.

'The slip will be about 900 yards long, and as the upper 'portion already tried measures 150 yards and cost about Rs. 150, 'we may calculate that with more substantial work it will cost 'about Rs. 1-8-0 a yard, or say within Rs. 1,500 to do the whole 'line.

'I think the work is feasible and my only doubt is as regards 'the last 100 yards or so which will be very steep, but which may, 'if necessary, be improved by a raised platform on trestles or a 'bund or by diverting the course so as to take in a hill side on the 'south. The saving in carriage on a take-out of 50,000 cubic 'feet a year would be nearly Rs. 2,000.

'The upper portion of the slip laid by Mr. Bryant roughly 'averaged 15 degrees (1 in 3½) gradient for 100 yards (the start for '20 yards was 23 degrees or 1 in 2½), and then 9 degrees 1 (in 6) 'gradient for 50 yards; and one ton logs took 20 seconds to do 'the 150 yards, so that logs would take about 2 minutes to do the 'whole slip when completed—a rate of about 15 miles an hour.

'The pace of a log will depend on the state of the slip. In 'wet weather logs would travel too fast. The slip will have to be 'sanded or greased according to weather and gradients."

We are glad to learn that the working of the Anamalai tramway has been a success, although "the rails are too light for the 'work and the trucks unnecessarily heavy."

The *North Malabar* Inspection note is annotated by the Collector and is more interesting from a true forest point of view than that of S. Coimbatore, though there is nothing much requiring special quotation.

The *Nilgiri* note we have naturally read with some interest and a great deal of disappointment We are glad to see that the Conservator appreciates the point that 'fires' on grass lands 'destroy 'the finer class of grasses' and that in large grazing grounds like these of the Kundahs, the outer edges usually get much over grazed while the further portions are hardly touched. We entirely agree with the Conservator that the idea that 'shola' would not reproduce itself from coppice is a mistaken one. There are fine pieces of coppice regrowth in the middle of Coonoor Peak Forest and at Naduvatam, and the idea which underlies the Collector's remarks about such work having been 'tried and resulted disastrously,' is, in our opinion, simply due to impatience. Those who do not understand Forests and their treatment professionally, are sometimes apt

to think that, because the show of reproduction made in the first few years is not very apparent, therefore the reproduction is a failure ; and in the Nilgiris this tendency is intensified by the ever present object lesson of the Eucalyptus. People who see the Blue gum reach six feet in height in a year are disappointed because shola-coppice scarcely reaches much more than as many inches. The whole of the Nilgiri sholas, in our opinion, very badly require treatment; and if careful treatment, under professional officers, is not given them, they will by slow degrees deteriorate and as one by one the big trees fall, their place will be occupied by bushes and scrub and *not young trees.* But we fear that until such matters are left to professionals, the sholas of the Nilgiris, like the New Forest and parts of Fontainebleau will have to continue to be treated by '*exploitabilité physique.*' Our disappointment, to which we referred at the outset, was due to the absence of any notes on the results of the blue gum and wattle working plans. There are very few Forest Districts in India which are so interesting, if properly managed, as those of the Nilgiris, but there are 'too many cooks' and if the Government does not soon insist on a simple Working Plan for the whole District, including all the Working Circles, teak, blue gum, shola, etc, and then order it to be carried out without interference, change for cavil for at least 20 years, prohibiting the Collector and Forest Officer from listening to amateur advice, there is likely to be worse deterioration than these reports shew and the forests will be converted from samples of what ought to be done, into samples of 'how not to d it.'

We have been led to some extent to these remarks by noticing that the Board are going to ask Mr. Popert to visit the Teak Forests and give his advice based on his long experience of teak in Burma, and we venture to suggest that his visit might be extended to the sholas and the plantations of blue gum. The other remarks of the Board are good and suitable, and their suggestion regarding the possible import of Mudumalai woods, other than teak, for use in the hills, is one which is fully worthy of consideration.

The *Madura* Inspection note we cannot understand. The Conservator's report says he was in the District for 23 days, but the Divisional Officer was apparently unaware of it. Here too, as in S. Coimbatore, we have explanations by the Divisional Forest Officer on the Conservator's remarks and these explanations are long: however, if the latter's inspection was not made in the presence of the former, this is hardly to be wondered at. We reproduce the remarks of :—

(1). Conservator.
(2). District Forest Officer.
(3). Collector .

en the region which bears the romantic name of the 'High Wavy Mountains' as likely to interest our readers. We should

like to hear more about these hills and wish Mr. Gass would send us an account of them after his next visit.

"1. *Conservator.*—I had arranged to go across the so-called 'High Wavy Mountains with Mr. Gass, but the weather was un-'propitious and the trip had to be abandoned.

'I have, however, approved of the District Forest Officer's 'proposal to make early application to built a rest-house up there 'and to secure a decent bridle-path approach to it.

'I would suggest a site for the rest-house as near the Suruli 'water-fall as possible. It would be higher and more central than 'the site suggested further north.

'With a path up, and a building erected, there would be 'greater chance of these fine hills being developed.

'At present little is known about them, beyond that they 'range between 5,000 and 6,500 feet; that the sholas there are 'extensive and dense; and that the only forest produce at present 'brought down consists of cardamom and the beesha reed.

'It is fortunate that we have been able to make them reserved 'forests, for they appear to catch the clouds of both north-east 'and south-west monsoons, and, judging from the size of the 'Suruli water-fall looked at from below during the rains, they 'must tap the clouds to a considerable extent.

'I do not know what the exent of the drainage on the top 'of the hills is, but it apparently all falls into the Suruli river on 'the Cumbum valley side of the hills."

'2. *District Forest Officer.* I have submitted detailed pro-'posals for the construction of a rest-house on the High Wavy 'Mountain and for improving the present path, in the Budget 'Estimate and annual Plan of Operations for 1893-94.

'I do not much care where the rest-house is located. The 'place I suggested has a path already leading to it. The site near 'the water-fall is more visited by elephants. It is no doubt more 'central, but is at a slightly lower elevation than that suggested by 'me. The water here flows from north to south to the water-fall 'and not *vice versâ.*

'A rest-house on these hills and a decent path up to them 'will certainly facilitate inspection and render it a more comfor-'table affair than it is at present. This range of hills is, however, 'better known than the Conservator appears to think. I have been 'up them frequently; always once, and sometimes twice, in the 'year, and I have been through them in various directions. The 'whole upper part is covered with evergreen forest, and not 'merely a series of large and dense sholas. This forest covers the 'top and runs down in long irregular shaped masses for a consider-'able distance on either side. The whole drainage from the top is 'into the Cumbum valley, as may be seen on the map. The 'Suruli river has two long branches, which, rising at some distance 'north and south of the water-fall, meet close to it, after flowing 'in almost straight lines towards it.

'The importance of these hills from a climatic point of view
'is very great indeed. This reserve was selected by the Forest
'Committee in 1880. The area of the top or plateau, if it may be
'so called, is probably about 15 square miles. Below the evergreen
'forest there is a zone of bare rocky grass land, and the lower
'slopes are well covered with valuable forest and are constantly
'visited and inspected."

3.—'*Collector*.' I went to the top of the "High Wavy" with
'Mr. Gass and am decidedly of opinion that the forest on the plateau
'should be better inspected. A pathway up and a good rest-house
'should be made.

'The ascent is very steep, it is almost impossible to get tents
'up. There is too much indiscriminate cattle-grazing and shooting
'in all the forests of the Cumbum valley."

Chakla Drogmula.

(*Continued from page 315 and completed.*)

Three is one drawback in the case of the Kandi Forests and that is the distance from the Pohru River which is a measured three miles, so that heavy logs over six feet in girth cannot be conveyed to the river at present Srinagar prices, *viz.*, six annas per cubic foot in the log, we must therefore resort to the sawing of scantling. Hitherto the custom has been to fell only second and third class trees, because these could easily be transported overland, but this spells ruin to the forest. It might be supposed that the number of first class trees must be enormous, but this is not the case, since many have been cut to provide boat planks (*takhtas*) and many have been killed by that pest, the village mochi, who used to remove a strip of bark from all round the base of the tree, thus causing it to die. It is exasperating in the extreme to see the way land has been cleared in the very centre of the forests, first the bushes are cut, then the trees barked, so as to kill them, and finally the bushes are heaped up round the foot of the trees and fired. If any trees are felled they are left lying on the ground till dry and then burnt and this in a country where every portion of the tree is valuable and can be exported to the city at a profit. But again, are these ignorant, simple people, as blamable as our own early settlers in Australia, or as the Americans and Canadians at the present time? Do *they* look ahead to the time when timber will be scarce? Not if all accounts be true. Our aim will now be to induce the public to use blue pine instead of deodar by reducing the price; there is no good reason against the use of the blue pine in Srinagar, especially with the example of Murree to go by, which it is believed, is almost entirely built of that species. The Forest Department in Kashmir is much hampered in the delivery of timber by the fact that the Pohru River only contains sufficient water for floating logs of any size during two or three months in the year, when the snow is melting, after that it is a wretched puddle, only fit to carry small poles or scantlings. Here bullocks are used for dragging timber from the forest to the river; a loop is cut in the end of each log through which a rope is passed and some 8 or 10 bullocks are then yoked to the log. The people have an ingenious plan of turning a stream of water on to the dragging path which reduces the friction. Early in the season, when there is abundance of water in the various

small streams coming from the hills, a dam is made at a certain place below the forest, and inside this, a deep pool of water collects; to this there is a sluice gate opening into a nala which joins the river, the logs are dragged as far as the sluice, put in below, and the sluice is opened and the logs swept down to the river. This, however, is of no avail later on, and the logs have to be dragged the whole three miles by land.

A relic of the past is the system of advancing money to bring out timber, the villager considering the wood his own property till his account has been settled! I found some unmarked logs lying near the forest and on asking a question, was told they were not state property for the above reason. The result of this system of advances is, that there are now hundreds of logs scattered about in the village lands outside the forest, which have been lying there for more than four years and notwithstanding any number of orders of an urgent nature, no one has stirred to deliver them at the water's edge. The villager was paid in full, five years ago, so having nothing to get, he does not care a bit for orders and there the logs lie rotting; if the Department spends more money on them, it might whistle for it, for any chance it has of getting it back from the villagers, so that the only way will be to get some gentle pressure put on them through the Civil authorities; altogether, it is a most unsatisfactory state of affairs. In connection with this, it is curious how the present system of taking land revenue in kind, acts and re-acts throughout the land. Thus, the villagers would rather be paid in rice than in money and one of the first requests contractors make is for *shali* (paddy) and of course they want it at the rate of Rs. 1-4 per *kharwar* or 86¾ seers, because it is sold to the city people at this rate. It is almost impossible to buy any rice out in the district, it would appear that those who have it are afraid to sell it at a fair rate and do not see why they should accept the State rate, so that it is most difficult to get even the small quantity required by one's servants. This Department is enabled to get a small stock by an old rule which permits it to levy contribution on each boat load of state *shali* as it passes down the river and this forms our stock, from which to supply contractors for their workmen. It will be a great thing for the country, when all land revenue is taken in cash and villagers can sell their grain at the market rate, which is higher than the State rate. Formerly cotton and other products were accepted, but some of these had to be abandoned, as it was found that the rate fixed for, say, cotton, was much higher than it was worth, consequently the sharp villager poured in as much cotton as he could procure and the State was left with a store of stuff saleable only at a loss. It seems absurd to go on selling rice at the present rate, when it is worth much more and when everything has risen in price, and servants now get higher wages than in the Punjab to mention only one item, but, of course, the system must be gradually changed or there would be the usual outcry. Another way in which this Department is affected by the State *shali* supply, is that in order to keep

up a sufficient stock in the City last winter, the authorities had to impress all the boats they could lay hands on, consequently very few were to be had for the conveyance of firewood and timber; this is very unfortunate, as the natural result is a scarcity of both in the city and, of course, the poor F. D. is represented as being the cause of it all, because it would not allow indiscriminate fellings as before, whereas this has nothing whatever to do with it!

J. C. Mc. D.

Treatment of Waste lands in the Low Countries.

The great sandy formation which covers the largest half of the Netherlands, passes out of Holland into Hanover, and stretches entirely across Northern Germany into Russia, the medium level of the whole district being only about fifty feet above the sea, and nowhere rising above three hundred. It is geologically very ancient, and its surface is marked by foreign rocks, which lie scattered over its surface, supposed to have been transported thither by icebergs from Norway and Sweden, in some previous geological epoch. This formation makes the principal part of Northern Europe one great sandy plain, with very little landscape beauty, except that which arises from great green stretches overhung with a vast and ever-changing sky, which have served as an inspiration to a race of landscape artists, who have rendered, with Dutch fidelity, the features of their country. "Les accidents du pays," says L'Esquirol, "sont dans le ciel," but these apparently meagre details have been enough for Hobbema and Rüysdael and Cüyp to work with in producing their immortal canvases. Alternating with this sandy district, in Holland, as well as in Belgium, are extensive heath and peat lands, which afford another example of the way in which persistent industry can overcome obstacles in husbandry. These peat beds have been worked for five hundred years, so that the deposits in many cases have been entirely exhausted; but undismayed, the persistent Dutch farmers drain the holes by pumping, and put them under cultivation, the basis being clay which is

capable of being converted into a good soil. It is not uncommon to find at the bottom of these excavated basins, the remains of old forests ; but what would other people think of making farms in such cellars as these and by such tedious processes ? They begin by trenching the beds in which the peat is only fit for use after eight years, the deposit being often more than thirty feet in thickness, and only capable of removal by very slow degrees. This peat cutting, however, is a great branch of industry in Holland, for it is the only fuel the country produces, there being no coal, and but a very limited supply of forest. The growth of peat is here still in progress, and the same curious phenomena are still to be observed that were noticed by Pliny in the time of the Roman occupation. For example, fields are still found floating upon the water, and rising and falling with it. The Dutch maintain that the whole town of Dort, a large and flourishing place, shifted its location during one of the inundations. During another, a field on which ten or twelve cows were feeding, was drifted across the Dollart, a broad sheet of water many miles in width, which forms the boundary between Holland and Hanover, and fastened itself on the opposite shore in a foreign country, without the loss of an inhabitant.

The theory which prevails in regard to these peat beds, is that they have been formed by the growth and gradual destruction of aquatic plants, growing in shallow pools and lakes, forming a vegetation which originally floated on the surface of the water and finally attached itself by its roots to the bottom, extinguishing the sheet of water by transformation. But it is in the heath lands of Holland that the greatest results have been achieved by industrious and ingenious exploitation. As late as 1842, they were considered nearly valueless, so that in that year the state sold about 60,000 acres at sixteen or seventeen cents an acre. These lands, subjugated by a regular, though varied, system of cultivation, have been so successfully handled, that twelve years after the original sale 20,000 out of the 60,000 acres were resold for nearly two dollars an acre, and since then some of them have brought as high a price as ten or fifteen dollars an acre.

The methods adopted with these waste lands are various. One is sheep feeding on such parts of the ground as admit it ; another is to shave off the sod, pile it in heaps in the sun to dry, burn it, and dress patches with the ashes or spread them on the contiguous sandy lands.

But the favourite method of reclaiming both heath and sands, is the planting of forests of Firs and Pines, which is done with the extraordinary patience that characterizes this indomitable race. Though the profit is slow in coming in, it is found to pay in the long run. The seedlings, a year old, are planted at the rate of 13,000 to 14,000 to the acre. They are first pruned in the seventh year ; afterwards every two years, the trimming

paying the expense. At the end of twenty years they are cut for hop-poles, at twenty-five years for supports for galleries in coal and other mines. In fifty years they furnish timber for small buildings, and then the land is finally cleared off and regular cultivation is begun, the soil being by that time fit for working. Poor lands, treated in this way, are estimated to yield an annual product of four or five dollars a year per acre during the process.

The ancient method of treating the heath, which was introduced into Holland some two centuries ago, was copied from the Tartars, who have practised it from time immemorial on the plains of Asia. This consists in burning the sod over vast tracts at once. At times, this is done to such an extent that the air is filled with smoke for hundreds of miles, as in the burning of our great forests. After this, the ground is merely harrowed and sown with buckwheat or other grain, of which the product is twelve or fifteen bushels to the acre. The land thus treated can be cultivated for about seven years, yielding for the first three years a good harvest. Then the crop begins to fall off and in three or four years more it dwindles to little or nothing, and the land is abandoned. After resting for twenty years it is found to be in a suitable condition to burn again. In Asia the Tartars wander backwards and forwards over the immense steppes of lower Siberia and northern China, moving to another tract when one becomes exhausted. These wandering races have been known to remote ages, and isolated bands of them drift into Europe and form a valuable proportion of the labouring population of Russia. But in the rest of Europe, and more especially in diminutive Holland, these larger features of heath cultivation are now wanting.

These pictures of struggling husbandry on sterile soils are by no means without their use. They afford an instructive lesson to the patient cultivator of stubborn and unproductive lands, who may learn from them that, however great his drawbacks, there are other people with greater ones. They teach, also, that there is no piece of soil so bad that it cannot by skill and industry be made to produce some kind of a crop which will repay its possessor for exercising his intelligence in its management.—(*Garden and Forest.*)

News for Foresters

A correspondent writes "one lives and learns! Let me 'commend to the notice of the *Indian Forester* a para. in the 'Indian Agriculturist' for August 12th, 1893, p. 438 on 'the evils 'of transplanting." The following is the para. referred to :—

"A tree intended for timber should never be removed from 'the spot on which the seed germinated. No matter how carefully 'the removal is effected, the point of the tap roots is broken, 'and when that is the case the tree will never attain as great a 'height as it would have done if left to grow after nature's own 'fashion.

'It is from the system of transplanting that oaks grown in 'Britain acquire that round-headed habit which is their general 'characteristic. There may be some cases in which the direct 'descent of the tap-root of self-sown trees has been checked and 'diverted from the perpendicular by meeting with an impervious 'subsoil or rock. The effect in those cases would be nearly 'identical with that of transplanting, but as the tap-root may 'not have lost its point, the effect would sometimes be less plainly 'marked. The German high forestry system is based on the plan 'of imitating nature—*i. e.*, of sowing the seeds where the trees 'are to stand. All the treatment given thereafter consists of 'thinning out the trees at intervals, and on these occasions 'allowing a little extra room to those that are intended to be 'the permanent members of the forest."

Comment on our own part would be superfluous, so we leave this gem for our reader's amusement.

THE
INDIAN FORESTER.

Vol. XIX.] October, 1893. [No. 10.

A tour in Jaunsar.

The Mundali Deodar Forest.—The area included in the working plan for this forest comprises 3,222 acres, of which some 2,700 are estimated to contain deodar. The lines of export lie along the ravines, or 'Gadhs' as they are locally termed, and of these there are seven, as follows :—Bamnai Gadh with an area in its basin of 488 acres, Tutua Gadh, 390 acres ; Barsoti Khala, 164 acres ; Girgat Gadh, 623 acres ; Dugra Gadh, 762 acres ; Lakhna Gadh, 338 acres; and Sarni Gadh, 457 acres. Eventually all these streams flow into the Dharagadh, down which sleepers are floated to the Tons. The bed of this stream was made suitable for floating by blasting rocks, &c., in 1889, at a cost of Rs. 3,000.

At present, only dead standing or fallen deodar trees are being exploited. The sleepers are cut in the forest, and are carried by men to Deikhera on the Dharagadh, a distance of 6 miles. They are floated from Deikhera to Chadiar, 3 miles lower down the stream, in the months of July and August, when there is sufficient water in the stream.

In October, when all danger from the sudden floods is past, the sleepers are taken down to the mouth of the Gadh, and when the sleepers from Deota arrive, are pushed into the Tons itself to join them. The sleepers are launched in the Dharagadh 5,000 at a time and are caught at Chadiar by a weir thrown across the stream.

In 1890 the weir was placed at the mouth of the Dharagadh, and all the sleepers were floated down it at one time. During a heavy flood the weir broke, and 13,000 sleepers were swept into the Tons; of these 2,200 were never recovered.

Sleepers can only be floated down the upper parts of the Dharagadh when the water is at its highest level, that is in July and August.

The cost of delivering a sleeper on the banks of the Tons is follows :—

	A.	P.
Cost of sawing per sleeper	3	3
Carriage to Deikhera, 6 miles, each	3	0
Cost of floating to mouth of Dharagadh, 5 miles ...	0	6
Total ...	6	9

Floating is much cheaper than carriage by men; manual labour is not available during the rains, when the carriage has to be done.

The following table shows the number of trees removed and the yield of sleepers obtained from them :—

Year.	Compartment.	Trees felled.		Outturn of sleepers.
		Half dry.	Dry.	
				M. G.
1888 ..	11 and 12 part of 13 and 15	100	135	10,405
1889 ...	15 and 18 part of 14 and 20	605	373	39,124
1891 ...	...	360	248	32,853
1892 ...	...	272	292	25,525

Previous to the sleeper works, the only fellings that took place were for the supply of free grants to villagers, chiefly in the 'khats' below Chakrata.

With regard to the conditions of growth of deodar in this forest, it has been calculated that this species attains a girth of six feet in 130 years, whereas the same girth is attained at Koti Kanásar in 80 years. After the age of 130 years, the deodar here grows very slowly; hence there is no object in postponing the deodar fellings beyond that age.

The chief companion of deodar in Mundali is the spruce fir, the silver fir being found near the ravines and on the moister slopes.

Owing to the deodar growing up in a dense leaf canopy, the boles are clean and free from knots; on the other hand the crowns are narrow and contracted and very few of them are in the necessary condition to bear seed; the consequence is that we find very little reproduction: the seedlings that we do find growing under the leaf canopy and constituting the advance growth, are thin and weedy, with very little foliage and growing slowly; they present a marked contrast to seedlings growing out in the open, under favourable conditions, as may be seen here and there at Mundali, and frequently at Mashak, Koti Kanásar, and elsewhere. The most striking point about them is their very sparse foliage, showing none of the bluish appearance found on more healthy seedlings, and with a length of annual shoot that rarely exceeds one inch. One may compare them to the suppressed deodar plants found under the thickets of blue pine.

In order to improve the growth of deodar, girdling operations have been undertaken. The object of these operations is the removal of all trees which are dominating or suppressing

deodar trees, and also to give room for the expansion of the crowns of the mature deodar trees with a view to increasing their seed producing powers. The chief species girdled is spruce fir and such broad-leaved species as are found here and there associated with the deodar are also taken. Where no deodar trees exist on the area no trees are girdled.

Certain fixed areas are taken in hand every year according to a definite scheme. The results of this girdling which began in 1883 are visible throughout in the shape of dead standing firs and oaks and it is certain that the deodar has benefitted thereby. The spruce fir takes about two years to die, and the Moru oak from 5 to 6. In the case of the latter species, it is necessary to remove every particle of the cambium layer otherwise a callus will be formed connecting the bark above and below the girdle, and the tree will continue to live. Several instances of this may be observed.

The rocks here belong to what is known as the Mundali series. They consist principally of conglomerates, in which angular pebbles of quartzite, slate or limestone are cemented together by a calcareous, silicious or slaty matrix. The series is younger than the Deoban limestone, on which it rests unconformably and it is largely developed near Kalsi. The resultant soil is a rich free loam, excellent for the growth of forest trees.

We visited Nursery No. 1 situated below and to the N. W. of the Bungalow. It is irrigated from a spring, some 600 feet distant, on the percolation system, *i. e.* water is admitted into trenches 18 inches wide between the beds, and soaks through to the roots of the plants. There were 63 beds, containing 7,145 deodar plants three years old ; and 1,770 deodar and 639 blue pine, just germinated. The average height of the three year old plants was about 9 inches ; they are 6 inches apart in lines 10 inches apart. They will be ready for putting out in July. The aspect of the Nursery is N. W., it is well drained, and sheltered by large trees at the sides. The soil, which is a stiff yellow loam, is improved by large additions of vegetable mould, brought from the forest.

There were also some plants in baskets. The baskets are 6½ inches diameter, and 9 inches high, and they cost Rs. 2-8-0 per 100 ; they are made of the common ringal.

Another nursery, No. 4, contained 872 deodar plants with an average height of 10 inches. Last year there were 3,028 with a height of 7 inches and about ⅔rds of these were put out into the forest that year. The general plan in these nurseries is only to put out the strong plants, leaving the weaker ones for another year ; transplanting into nursery lines two or three times ensures bushy roots being formed, and prevents the formation of a tap-root.

We also visited the various plantations. In May 1892, 135 basket plants, 2½ years old, were put out by the Forest School students ; this year the average length of the annual shoot is 8 inches which shews that they are doing well. The plants are

protected by Indigofera and other shrubs. These plants were put out in triangular patches, 5 feet from plant to plant, the whole triangle being hoed up.

In plantation No. 3 of 1892, a small area of 54 poles was hoed up, and the following plants put out:—400 ordinary transplants, 135 basketted plants, and 300 with a ball of earth. The average length of the annual shoot of the basketted plants was 7½ in. while that of the others was 6½ in.

Near this plantation we noticed a patch of forest stocked with spruce, moru and silver fir, the soil a rich moist loam, aspect North West. Here several trees had been girdled to give light to deodar planted underneath, and as pits had been prepared, the students, for an exercise, put out 200 deodar plants with a ball of earth 5 feet apart in triangular patches, but they will not make much growth until the girdled trees die, as they do not receive sufficient light. In 1889, Deodar and kail were sown in pits over an area of 26 acres in compartment No. 13 to the west of the bungalow. The plantation is in two places. The aspect is S-W. 10,250 pits in all were sown; the sowings failed and the pits were resown in 1890. Nearly all the pits inspected in 1891 had young seedlings in them a few months old. The soil is rich and loose and contains a good deal of humus. The plantations are in sheltered spots and the ground fairly free from the growth of harmful weeds. The seedlings are looking healthy and strong; 2,150 deodar plants were put out in this area in July and August, 1889.

In compartment No. 13 we inspected the plantation made in April of this year. The aspect is S. S. W., steep slope 35 degrees, soil hot and dry with Ban oak, Rhododendron and Aiyar scattered about; 350 basketted plants of deodar and 350 blue pine in baskets were put out alternately in contour lines, 5 feet from plant to plant, and 10 feet between the lines. The plants were 3 years old, and had been in the baskets one year.

Further on, we noticed a plantation of 1891, in which 1,380 deodar and 1,660 blue pine were put out with a ball of earth to fill up blanks. Although the aspect is S. the place is sheltered and the plants are doing well. The older deodar plants in this area had last year an annual shoot of 16½ inches.

Planting in groups of five in 10 feet square patches, 30 feet apart has also been tried; the whole patch being well cultivated; 528 patches were thus prepared and plants put out with a ball of earth in July 1891. Under Indigofera and light shade, this kind of planting succeeds well. Last year the average height of the plants was 18 inches and of the annual shoot 11 inches.

Sowings in situ have been tried on two systems: first, the ordinary patch sowing in contour lines 10 feet apart on an open spur in compartment 10; 1,005 patches were sown with deodar in December 1890 and the seed germinated in March 1891. The soil is not deep, and the sowings have not been a success. Secondly, in plots of ground completely hoed up, 10 ft. square. About

200 seeds were sown in each plot in December 1890, and in 1892 the average number of seedlings in each plot was 20. These large plots can only be recommended among Indigofera, &c. They will never answer on bare hill sides.

It will thus be seen that during the last few years, sowing and planting of deodar has been tried by a variety of methods, and the experience gained so far shews that by far the best method in the end is that of basket planting. The roots are not disturbed, and the plant can be put out in the spring whenever the weather is favourable as in 1893, so that it has the whole growing season before it. If it costs a little more in the first instance, it is probably cheaper in the long run as there are no blanks to fill up—all the plants appear to live. The next best system to this is planting with a ball of earth. It is very difficult to raise blue pine from seed except under most favourable circumstances, and, as it has to be planted as a nurse, for this species too, basket planting would appear to be most suitable.

The upper portion of the Tutua block and a portion of the Bamnai block are set apart as a high level grazing ground for the sheep and goats of Jaunsar, which come to graze here in the summer when the valleys below are too hot for them. This area is too damp and high for deodar and chiefly carries a scattered crop of *Prunus Padus Pyrus lanata*, and maples on the gentle slopes near Kinani Pani we find magnificent specimens of spruce and silver fir. The following measurements taken with an Abney's level in 1892 will be interesting :—

Spruce fir, height	...	177 feet, girth	20	feet.
,, ,,	...	202 ,, ,,	19	,,
,, ,,	...	215 ,, ,,	19	,,
,, ,,	...	176 ,, ,,	...	,,
Silver fir, ,,	...	172 ,, ,,	13½	,,
,, ,,	...	184 ,, ,,	...	,,
Moru Oak, ,,	...	151 ,, ,,	17	,,
,, ,,	...	120 ,, ,,	12	,,

(*To be Continued*).

Located Fellings: a first step towards regular Working Plans

In their recently issued Report on Forest Administration in Madras during 1891-92, the Commissioners of Land Revenue assert that the advocacy of elaborate working-plans must be more or less a "counsel of perfection" until the immense work of forest settlement, combined with that of organizing fire protection and of training an efficient staff of subordinate officers, is completed. The value of this assertion must depend largely upon the degree of elaboration which, apart from the views of the non-technically trained heads of the presidency forest administration,

is held by competent foresters to be really necessary or desirable under present circumstances. The Local Government, however, in its orders on the Report, goes further and clears up the question somewhat. It has laid down that the preparation of plans for working the forests on scientific principles would be premature until the problems of settlement, &c., have been solved. It is needless, perhaps, stopping to consider whether these orders are equivalent to the admission that the 7,000 square miles of forest already settled may be managed on unscientific principles, until all the reserved lands and other forests, aggregating some 14,000 square miles, which it is in contemplation to settle under the Forest Act, have been legally constituted. For the moment it may be interesting to compare the views on this question held respectively by the Madras and Central Provinces administrations. In the latter provinces, conditions bearing on the preparation of Working-Plans are at least as unfavourable as in Madras. Forest settlement—which in this case means the determination as to what portions of the existing reserved areas shall be permanently retained under strict conservation, and what may be made available for cultivation, is in active progress, while there is an insufficiency of establishment under all heads—none the less the local authorities will not accept the *non-possumus* of Madras and insist on following up a middle course, such as might, indeed, have occurred to the Madras Board had it made enquiry regarding the successful substitution of the coupe for the indefinite permit system in Salem, a district of which, by the way, the forest settlement is not half-completed.

In an important Resolution, issued at the beginning of this year, in which the introduction into the Central Provinces of the system of located fellings on an immense scale has been ordered, it is said: "The Forest Department in the Central Provinces 'labours under a great difficulty in the want of Working 'Plans. Owing to the weakness of the forest staff, there is no 'immediate prospect of this want being supplied *in the regular way*. 'Some provisional steps of an *exceptional* character must therefore 'be taken, which will facilitate the collection of *data* preparatory to 'working-plans, while rendering the working of the forest some-'thing less haphazard than at present." The existing system, it is said, does not enable the agriculturist to obtain forest produce with sufficient facility and cheapness, while the issue of permits, covering all parts of the forest not wholly closed, does not admit of the forest being improved and the fellings properly supervised. The new scheme accordingly provides for the sub-division of the forest into such a number of convenient working-circles, blocks and annual coupes, as will bring the purchaser within reasonable distance of the produce he requires. Felling of green timber in each circle, whether undertaken departmentally or on the permit system, will be concentrated in the coupe of the year. The other coupes will, for the present at least, remain open only for grazing,

the cutting of grass and bamboos, and the extraction of dry fuel and minor products. The scheme, so far as can be judged from the general outline published, resembles that introduced some years ago into the Thana Forests of Bombay; and, in other provinces, similar expeditious methods for improving the character of the forest-growth and the system under which produce is exploited, are being brought into effect, especially when conditions for natural reproduction are satisfactory, and when the crops in each working circle are fairly uniform in character and demand little or no differentiation of treatment, the advantages of the system, as a first step towards the ultimate constitution of the crops according to various recognized sylvicultural methods, are at once apparent. It permits of far more rapid, more extensive and more material progress in forest organization than would otherwise, in most cases, be possible; it equalizes outturn and best satisfies local wants. It renders dishonest practices on the part of purchasers and of the forest staff more difficult of success. It lends itself according to the demand for produce and the means at disposal for the application of more intense treatment, to the gradual change from small beginnings to definite aims and ends, and does so without involving any material change of system. Above all, perhaps, it enables, in many instances, a relatively large proportion of the available establishment to be set free for employment in a few defined localities, and thus provides for that degree of supervision which allows of the advantages desirable from the elastic simplicity of the system being more fully reaped. Much naturally depends on the manner in which the framework of such a plan is prepared, and on the simple sylvicultural rules originally drawn up for the guidance of the executive officers. For instance, if a common felling—rotation for all the circles is decided upon, and an immense number of circles and coupes are laid out beforehand on large—scale maps without special inspection of the crops, without even calling in aid that comprehensive *coup d'œil forestier* of which the text-books speak, as is understood to have been done in some localities in India, subsequent embarrassments may prove considerable. But errors arising from the very simplicity of the system, and the main objection urged against working by area and cultural rules only, *viz.*, that the manner in which the crops are treated, in the case of improvement and selection fellings especially, cannot be controlled except after actual inspection, ought not to outweigh the advantages which, in the vast majority of the crops as they are now in this country, can be insured by the bestowal of a moderate amount of care. The coupe system, enforced in practice by means of the simple plans in question is that which seems *now* applicable to the great mass of our forests; whether the sylvicultural operations undertaken have in view the immediate creation of coppice or the improvement or restoration of crops with some ulterior object. Simple plans in such cases are preferable to those we are accustomed to in India which from their enormity of detail, can

occasionally only be applied in practice under the guidance of a specially capable officer, and are often widely departed from or abandoned after a few years trial.

The progress of forest settlement, the insufficiency of executive officers and the like, have no donbt greatly hindered advance in the organization of forest working. But it seems at least possible that what may be called the apotheosis of working-plans has had even a more deterrent effect. At the same time, there are some grounds for the idea that a working-plan in India is ordinarily intended to be an elaborate piece of work, entailing a very considerable amount of labour both before and after the application of its provisions. An administrative officer, whose business is regulated by the Indian code, may reasonably hesitate before ordering the preparation of numerous reports, each of which, as the Government of India lay down, must be drawn up *as far as possible* under 46 heads, comprising some 60 different subjects. Or he may have no particular wish to subject himself to the correspondence of "control" which, under the present orders, may arise if sanctioned plans are departed from even in particulars of no material importance whatever. In the next place, the departmental code nowhere explains that it is only as an exception, in cases, for instance where demand exceeds supply or where produce is specially valuable, that a plan need be of other than a simple kind, or that as a general rule, any considerable degree of elaboration and detail, encased within the straight-waistcoat of countless pre-scriptions scattered here and there in a bulky volume, is likely to defeat the object in view. On the contrary. A perusal of Code sections 83 and 86, leaves behind it the distinct impression that the short and simple plan, formulating a general scheme and leaving to the officers who are to apply it, the execution of minor details, is rather to be the exception. The Code, it is true, devotes five lines out of about eight pages to the subject of simple plans. But it does so, as it were, apologetically, apparently with a view to the provision of temporary and unsatisfactory substitutes for the more elaborate plans to be subsequently drawn up, following the procedure of the 46 headings *et cetera*. The counsel of perfection is probably first cousin to the counsel of despair. The influence of the code in this direction may be traced in the remarks of the Madras Board of Revenue and in the depreciative tone of the Central Provinces Resolution above-mentioned. Why should it be assumed that the procedure of which the outline is given in that Resolution is necessarily exceptional or irregular? These lines have been written in the desire to suggest, rather than with the endeavour in any way to prove that, in the present condition of our half-ruined and irregular forests, such simple easily understood and applicable plans need not be aplogized for but are indeed those best adapted to satisfy for years to come the requirements of the people and of the Forest Department, and should rather be the rule than the exception.

'VAGRANT.'

Wood Paving from India.

From the 'Timber Trades Journal' for July 29th the following notes on the gradual spread of the use of wood as a paving material, are worth reprinting, for they lead to a question which we may well ask ourselves in this country and that is: why should not India have its share in the supply of wood paving blocks for the streets of the cities and towns of Europe and America and probably of India itself?

'Wood Paving.—The Ipswich Paving and Lighting Committee have accepted the tender of Mr. B. G. Elliott, of Kentish Town, N. W., to supply jarrah blocks at £13 per thousand.

'At the meeting of the Camberwell Vestry, Mr. Wallace brought up a report of the surveyor's estimate of the probable cost of repairing Rye Lane, Peckham, with wood blocks. The cost of carrying out the work from High Street to Blenheim Grove was estimated at £2,000, and from High Street to Choumert Road £3,000, and from High Street to Sternhall Lane £4,000. The Committee recommended that temporary repairs be carried out at a cost of about £60. This was agreed to.

'The London County Council have agreed to pay half the cost (£4,405) of certain wood-paving works in Paddington, and to contribute £1,450 to the cost of paving the space between Sussex Place and Chester Place with wood.

'The Finance Committee of the London County Council admits that there is good ground to assume that jarrah wood will last longer than deal, and hence the Council allows seven years for repayment of loans on its account. But on Tuesday it declined to advise the Council to extend the period beyond that time. Consequently they have only consented to the St. Pancras Vestry borrowing £24,000 for jarrah or karri wood paving, on condition that it be repaid in seven years.

'The Strand District Board has received permission to borrow £7,000 for wood and asphalte paving works.

'The London County Council is about to pave the Whitehall Place approach to the Victoria Embankment, in equal portions, with jarrah and karri wood respectively, at a cost of £3,100, in order to test the two kinds of wood. The work will be carried out by the Works and Stores department.

'The Woolwich Local Board of Health on Tuesday accepted the tender of Messrs. Mowlem & Co. to lay jarrah wood paving in the vicinity of places of worship."

The noticeable point is the great use which is beginning to be made of the two great West Australian timbers 'jarrah' and 'karri' and the flaring advertisement of companies to work concessions of forests of those species are not uncommon in the newspapers. But surely we have in India timber just as good and procurable from forests situated on good rivers within easy distance of the coast which could compete in every respect with the Australian trade. If

the Ipswich rate is anything like an average, it comes to about 3d. per block, and if each block is 4 in. square and 6 in. deep, to 4s.-8d. cubic foot.

It seems probable from the indications we publish and from other information, that most European and American towns will sooner or later replace their old stone, asphalte or macadam pavement with wood. Since it has been proved that, by the American method of hot air drying, all fungus germs can be killed and all albuminoid substances so desiccated as to obviate development on them of fungoid growths without interfering with the physical qualities of the timber, many of the objections to wood-pavements have been removed and especially those connected with sanitation. Consequently, the gradual introduction of wood in road-paving is merely a question of time, and those who are interested in finding markets for surplus forest produce ought not to pass the opportunity of sharing in the demand which it may safely be anticipated will shortly spring up.

It seems that hard heavy woods like 'jarrah' are likely to be preferred to the softer deals and pine which have been used so much in London; and it is just these heavy woods of which we possess in some of the Indian forests, such a large quantity which at present has litttle or no sale. It has always been more or less a reproach against the Indian Forest Department that railways have been made through its reserves and these reserves have not assisted in the supply of sleepers. The causes of this are easy enough to understand, and are (1) the preference which the companies shew for iron sleepers which can be provided merely on an order to a large firm and with comparatively little trouble in examination; (2) the desire of forest officers to make a good show of revenue and perhaps to stand out for too large a profit; (3) the want of labour and the difficulty of organization in new localities, often unhealthy; (4) the imperious necessities of Budget arrangements which prevent on the one side, the Public Works Department or the Railway Company from giving its order sufficiently long before hand; and on the other, the forest officers from getting ready sleepers when it is not absolutely certain that they will be purchased; (5) the small size of Indian trees except in the hills, preventing the economic use of any but the best and soundest and straightest of timber for such a purpose as sleepers, and so on; but in the case of wood-blocks these difficulties would disappear: for if the market is large, blocks can be cut for it without previously arranged contract for sale; a small profit will be better than none at all; the small size of the pieces makes extraction and conversion easy, and any trees having sufficient heart-wood for the purpose and otherwise sound will do. So that we think there is a great future for the industry and that it behoves those who are in charge of forests which have suitable timber, not to lose the chance which is now presented to them.

First and foremost among the likely woods, is undoubtedly the 'Pynkado' (*Xylia dolabriformis*) which occurs throughout Burma

and also in large quantities on the opposite coast in the hills of Vizagapatam and Godavari, all within easy reach of the sea and usually provided with cheap water carriage. Pynkado is already in use for telegraph poles and sleepers and we imagine that the new paving-block industry would prove economical as enabling less of the wood to be wasted, for many trees which might only give a few sound sleepers could also give in addition a fair number of paving blocks out of ends and sides and pieces with knots and similar flaws. We would suggest that an attempt be made by the Burma Forest Department to send home to some good agent for sale, a large consignment of 'Pynkado' and have it tried. Perhaps the well-known oil which fills the pores of the wood may make the preliminary use of a desiccation process unnecessary.

Then there are also many other kinds which might do, for instance, the ubiquitous *Terminalia tomentosa* the 'Saj,' 'Asan,' 'Toukkyan,' 'Maddi' of various parts of India seems just the kind of wood for the purpose. Then there is the 'Nagesar' or 'Gangaw' (*Mesua ferrea*) of which considerable quantities could be cut and brought to Chittagong, Akyab and the Burmah ports without much expense. Then there are the *Lagerströmias*, *Shoreas*, *Hopeas*, *Hardwickia*, *Soymida*, and doubtless many other names will occur to those who are in charge of forests in likely places such as the West Coast country from Bombay to Cochin, the East coast forests from the Kistna to the Mahanadi, the Chittagong Hills, the Sunderbuns, and the forests of Aracan, Pegu and Tenasserim—everywhere in short where a copious rainfall gives forests of large trees and a large supply of timbers of many species only a few of which have, like the Teak, an assured and permanent market.

It must be remembered by those who try for the new market that success is not always attainable at once. Every tradesman who starts a new business in a new commodity, knows that it takes a good deal of capital, some time, much advertising and above all plenty of patience to start a market, but that when once successfully gained, the returns flow in. It is no use giving up because a "small trial consignment' fails, the thing to do is to go on, to force the market and it will succeed in the end. We feel sure that if really strong measures are taken to obtain it, India will, before long, send to Europe and America paving blocks to the value of many lacs and the forest revenue bid fair by its increase to repair some of the losses which may result from the present financial crisis and by the attempts which are being made to reduce, if not abolish, the revenue from opium. A few years' time should see 'Pynkado' and other names as much household words in the European and American paving block market as are the 'Jarrah' and 'Karri' which our Australian neighbours have taken such pains to introduce and sell.

As a proof of what can by done in this respect, we need only point to the trade in Padouk which has been firmly established within the last few years.

Forest Planting in New York State.

Forestry in the United States has up to date, at any rate from a Government point of view, been a failure, and a failure as regards the whole country it is likely to remain for many years to come. But though it is not likely that Congress will take the matter up and pass general laws to constitute a Government united forest domain, to prevent forest firing, regulate lumbering, and arrange for the restocking of areas too denuded for natural reproduction; yet there are many signs that individual States are taking the matter up, and that, although not quite in the same way as is done in the chief European countries, in India, and in some British Colonies, a considerable step towards forest maintenance will soon be apparent. Among the pioneer States in the forest work, the foremost will probably be that of New York, the great State which stretches northwards from the great American seaport to the Canadian frontier and furnishes in the Catskill and Adirondack mountains some of the most beautiful localities of Trans-atlantic scenery. Dr. Jarchow's little book, which is now before us, is expressly published in order to act as a sort of Forestry text-book for the New York State and though no doubt here and there there will be found some useful advice and valuable information, yet on the whole the result cannot be said to be wholly satisfactory. Compared with such a really useful practical work as Dr. Franklin Hough's 'Elements of Forestry' in some respects Dr. Jarchow's work is only disappointing. The work is divided into three parts, 'Forest culture,' 'Forest planting on plains' and 'Forest planting on mountains.' In the first, after several general chapters of an introductory kind, ten pages are given to 'Systems of forest Management' and four to 'Natural reproduction' the rest being devoted to Artificial Reproduction of a more or less horticultural character.

'Scientific Forestry' 'our author tells us' 'does not designate any exact science' but consists in three points which are (1) sustained production, (2) natural regeneration, (3) progressive improvement: and here we have no doubt but that the author has very rightly consulted our old Nancy text book by M. M. Lorentz and Parade. We can only feel sorry that he did not consult it further.

'FOREST PLANTING' a treatise on the care of timber lands, by H. N. Jarchow, L. L. D., Orange Judd Company, New York and Kegan Paul, Trench Trübner & Co., London.

Properly preserved forests, he tells us, must : (1) be guarded from encroachment ; (2) be protected from injury of various kinds (3) be managed by three principles, *first* "the annual felling of 'mature, or defective dead trees and their transportation so that no 'damage shall be done to young growing trees ;" *secondly* "the 'periodical thinning out of places where the trees have sprung up 'too thickly ;" and *thirdly* the filling of vacant spots "by natural 'reproduction of the trees either by shoots, sprouts or layers, or by 'the natural sowing of seed" or "by artificial replanting." So far, so good, this is excellent as a beginning but the programme is not always properly developed.

Dr. Jarchow claims that the State should own ; (1) the forests and areas surrounding the watersheds of the navigable rivers ; (2) the sand-dunes along the coast ; and (3) every area unfit for agriculture but adapted for forest ; but his illustrations of the advantage of state management are not always happy as may be seen from the following extract.

'For instance, if a private person possesses a mine which cost 'every year $100,000 in order to obtain its yearly output valued at '$100,000, there is no net profit, and the owner of the mine would 'hardly be inclined to continue the enterprise, unless prompted by 'the charitable desire to give some men employment. From a 'quite different standpoint would in this case the question of the 'profitableness be considered, should the Government take this work 'in hand. The $ 100,000 paid for labor, machinery, etc., would 'then be looked upon as benefitting the people, and the nation 'would have by the continued exploitation of the mine a profit 'of $ 100,000 every year, that being the sum which had been dis-'tributed for labor, etc.

In the 5th chapter the advantage of Forest Schools is described and the School he takes for his model is not one of the well-known German institutions, or that at Nancy, but the comparatively minor French one of 'Les Barres' where some half-dozen subordinates are yearly instructed in practical work.

We do not propose to attempt to discuss in detail Dr. Jarchow's hints on the artificial rearing of trees for we know too little of the requirements of the individual American kinds. We prefer to let our readers judge for themselves, and say, that while wishing every possible success to New York Forestry, we hope the next writer will produce a work of a more suitable kind, and treat his subject from a wider point of view

New Indiarubber Rules in Assam.

The new rules introduced during the year with the sanction of the Government of India by which the old system of farming the collection of rubber was abandoned and replaced by the imposition of a duty of Rs. 12 per maund, on all rubber imported from beyond the border, or collected from trees growing on Government forest land, have worked very successfully from a financial point of view, the receipts from the duty collected during the past season having amounted to over Rs. 50,000 as compared to Rs. 25,585 received from the contractors in the previous year 1891-92.

The Rules only came into force on 1st November 1892, and there was naturally some little delay in getting them understood by merchants and others interested in the rubber trade. But when this was accomplished, the rules seem to have worked fairly well and to have given no cause of complaint to either hill man or trader. And although the exports of rubber were 1800 maunds less than usual up to 31st of last March, the returns of the following three month's ending 30th June 1893 prove that the trade has pulled up its lee way and even exceeded figures of recent years.

Eucalyptus and Malaria in Italy.

We have received from Mr. W. Coldstream, C. S., Deputy Commissioner of Simla, so well known as interested in Indian Arboriculture and as the author of an important work on Indian grasses, a letter just received by him from Signor Fortunato Cardinali, Secretary to the Agricultural Society of Rome on the subject of the work at the Tre Fontane Monastery to which reference was made in our June (p. 225) and August (p. 303) numbers. Signor Cardinali says :—

"It is true that many experiments have been set on foot in 'Italy with the object of ameliorating the hygienic conditions of 'malarious localities ; but the results have not been very satisfac-'tory because that exotic plant has only thriven with difficulty 'with us, probably on account of the difference between this and 'the climate of its native country, that is to say, Australia, where 'there exist immense forests with notable advantages as much from 'the hygienic as from the economic point of view. Here in Rome 'we have one example, near the estate called 'Tre Fontane'; 'where the Trappist Monks have occupied themselves in making a 'plantation of Eucalyptus since 1866 ; and although they have 'expended considerable sums of money and taken especial pains, 'they have only succeeded in raising some hundreds of plants out 'of so many thousands put out and those plants of relatively poor 'growth.

'The monks extract from the leaves of the Eucalyptus trees 'a liquor which is sold as an 'antifebrile tonic' but to fight the 'fever properly quinine is really wanted.

'I know that the cultivation of Eucalyptus in Algeria has 'succeeded in giving excellent results."

Signor Cardinali's letter seems to supply the answer to the queries put in Mr. Fernandez's letter in our August number ; and the facts appear to be that a great deal of rubbish has been written about the Tre Fontane plantations which does not accord with the real facts of the case, which are that Eucalyptus planting has been a distinct failure in the Roman Campagna, just as it has been in so many places in India.

Douglas Fir for Tea Boxes.

Mr. J. B. Spence of Ceylon has made an arrangement with the Ottawa agent of the Rathbun Company for a trial shipment of shooks for the construction of tea boxes. Of all the woods submitted, Mr. Spence favoured the Douglas fir, of British Columbia, which he considers vastly superior to the wood at present obtained from Japan. Shipments of fir box shooks can be made direct from British Columbia to Ceylon, and Mr. Spence believes that the trade will soon become one of the most important branches of the lumber industry. The tea trade of Ceylon requires about 1,000,000 boxes yearly.—(*Timber Trades Journal.*)

THE
INDIAN FORESTER.

Vol. XIX.] **November, 1893.** **[No. 11.**

A Tour in Jaunsar.

On the march from Mundali to Kathiyan we passed through some second class forest in the Ban oak zone which is burnt every year and used as a grazing ground ; and then we came to a small patch of temporary cultivation in which the trees are lopped and the branches strewn on the ground and burnt, and the ashes ploughed in ; *khil* is the local name for this system.

Along the stream at the bottom of the valley, we noticed many new species among which *Cedrela Serrata* and *Quercus annulata* were the most important.

With regard to burning the 2nd class forest, we read in the Journal of 1891 as follows :—

"A greater part of the 2nd class forest below Mandali had 'been fired intentionally by the villagers. This procedure is allow-'ed by the Forest Department, apparently as the villagers consider 'it necessary in order to improve their grazing. This, however, it 'does not do, as has been conclusively proved in Madras. In 'reality by firing the grass, most of the delicate annuals such as '*Panicum Oplismenus*, *Isachne*, *Poa*, *Eragrostis*, *Festuca*, which 'are especially good for cattle, are destroyed, while the coarser kinds 'such as *Andropogon Nardus* and *Schœnanthus*, *Apluda aristata*, '*Chrysopogon sp. sp.* and *Anthistiria ciliata* which are not so good 'for fodder, and of which only the young shoots are eaten, are en-'couraged."

The climb up from the valley, through village lands, to Jaknilani is steep and hot.

Kathiyan Forests.

The area of the Kathiyan forest is 608 acres. The whole of the forest was burnt in 1865 by the neighbouring villagers of Chajál to propitiate their deity on account of a severe epidemic of small pox which visited them. The forest has been preserved from fire since 1870, and in 1870-71 the 1st [illegible] 2nd class trees which had been killed by the fire of 1865 were [illegible]ed and converted into sleepers ; about 2,000 trees of each class were removed, and these yielded 10,000 broad guage and 10,000 metre guage sleepers. The sleepers were carried by men 12 miles to the Tons river and from thence floated singly to Dakhpathar.

The price then received for a broad guage sleeper at Delhi respectively was Rs. 4 and for a metre guage Rs. 2-8; the price now received is Rs. 2-8 and Re. 1-9 respectively.

Protection from fire has resulted in extensive reproduction of blue pine and deodar. On the south side of the hill above the village of Chajál, the deodar is quite as numerous as the blue pine, and in the struggle has held its own; the young saplings are growing quite as fast as the blue pine and have a healthy appearance.

On the north side of the hill it is probable that deodar at the outset was not so numerous, and thickets of blue pine 25 to 30 feet *high have sprung up and suppressed* the deodar. A casual observer might suppose that the deodar seedlings are much younger than the pine, but a careful examination of the *annual rings of the former* shows unmistakeably that they are of the same age; the two species sprang up together shortly after the commencement of fire-conservancy, and the deodar has lingered on under the cover of the blue pine, but has not prospered. Operations to clear away the pine were commenced in 1886, but they were not carried out with sufficient vigour and boldness. Some oaks and other inferior species about 300 in number, were also girdled. In 1888, a party of students worked for ten days, and cleared away about 5,000 blue pine, girdled 2,500 oaks and other species, and liberated nearly 9,000 deodar seedlings, and though this operation was carried out *rather* late in the day, it is hoped that the deodar will prosper under the *increased light given to them, and will now shoot ahead.* The whole area has now been done, but it is essential to bear in mind that the place must be revisited every three or four years, and the operation, if necessary, repeated. We have seen that deodar is capable of existing under cover for many years; but it is quite possible that some of the original deodar seedlings have already disappeared. We must acknowledge, however, that, with one or two exceptions, we do not find any distinct proofs of this.

The deodar seed bearers were chiefly on the ridge at the top of the forest, whereas blue pine seed bearers were scattered about all through the forest, this fact mainly accounts for the preponderance of blue pine in the thickets on the lower slopes. The soil which is a deep loam may also have favoured the latter species.

"On the top of the ridge above the bungalow we inspected the 'patch of deodar reproduction marked out by the forest *students in* '1887; its area is 550 square feet and it then contained the following 'saplings :—deodar 105 : blue pine 35; spruce fir, 6; other species '2. In the middl[illegible] an old parent deodar tree, from which probab-[illegible] most of these [illegible]g deodar have sprung."

This year we counted 97 saplings in the area, which would give about 7,682 per acre, the number in 1887, being about 12,120 per acre, an example of natural thinning. The number of deodar seedlings in a good seed year, that come up immediately under a parent tree is sometimes very large. We counted on one square

foot as many as 83 which had just germinated ; and in the Lambatach forest in 1888 we made the following remarks regarding natural reproduction of deodar and blue pine together, which are interesting as throwing light on the origin of these blue pine thickets :—

"On a grassy slope near the fire-line below "Dumbleton's" ' house, we counted the seedlings on a patch 10 feet by 10 feet and ' found 46 deodar of on average height of one foot, and 14 blue pine ' of an average height of nine inches. The deodar was about seven ' years old and the blue pine all ages from two to six : this would give ' about 20,000 deodar and 6,000 blue pine per acre. There were a ' good many deodar seed-bearers in the vicinity, which accounts for ' the large proportion of deodar seedlings but it is quite possible that ' in a very few years these 14 blue pine would completely suppress the ' 46 deodars. Hence it is absolutely necessary to watch such a crop ' from the very outset, and to clear away the pine as soon as they ' begin to get the upper hand of the deodar. Lower down on the ' same slope, the young stock is almost entirely composed of blue ' pine, and here it is probable that, at the beginning, there were very ' few deodar seedlings, because the locality is much further from the ' parent trees."

Near the Camp we inspected the result of the girdling of blue pine in 1888, and found that the girdled trees were quite rotten, and the average length of last year's shoot in the deodar was 13½ inches. The pine girdled in 1891, are now dying, their leaves being quite yellow. In 1892, we measured the lengths of the annual shoots of deodar of the last four years, in an area where the pine had been girdled, and found them to 6′, 7′, 9′ and 9·1′ respectively. These observations, as far as they go, tend to prove the beneficial effect of giving the deodar more light.

Tapping Chir Pine for Resin.

For a full account of these works the reader is referred to the Appendix Series of the *Indian Forester*, "Resin and Turpentine from Indian pines."

The following is a brief history up to date :—In 1884, 20 Chir trees were tapped on the Kumaon principle, *i.e.*, a nick is cut deep into the tree and the resin is allowed to accumulate at the bottom of the hollowed out nick, and is collected from time to time. The nick is 18 inches high, 12 inches wide and 41 inches deep, at the base. The trees were tapped from April to November, and the yield was as follows :—10 trees in the Dharmigadh yielded 30 seers, and 10 trees in the Chattragadh yielded 86 seers of crude resin.

Resin tapping works on a larger scale were started in April, 1888. They were of an experimental character, and the cost of extraction was consequently high and the yield of crude resin small.

1024 Chir and 501 Kail were tapped in the Bogur, Malon, Himus and Kathiyan blocks, 2,873 blazes in all being made, or nearly

2 on each tree. The work was begun by Dr. Warth and some forest students, and afterwards carried on by the local establishment.

Incisions were made 12 inches long and 6-9 inches wide. The cuts were freshened once a fortnight and at the end of November, 1888, were from 24 to 30 inches long, and 2 or 3 inches deep at the lower end.

The yield of resin in this year was 107 maunds or nearly 3 seers per tree.

In 1889, 1073 Blue pine and 3,215 Chir were tapped in the same forests, the yield being 2¾ seers and 6 seers respectively.

In 1890, 473 Blue pine and 115 Chir were abandoned as exhausted; and 1,540 Blue pine and 3,100 Chir were again tapped, but not worked to their full capacity, the cuts being freshened only once or twice a month. The yield was 37 seers of Chir resin, and 1 seer of Blue pine resin per tree.

In 1891 and 1892 the work was continued and there are during the present year 5,000 trees, all Chir, undergoing the process of being tapped.

The present system of tapping, which is adapted from the French, is as follows:—the outer bark is first of all removed for a space of several feet in height and about two feet in breadth; then an incision is made near the base of the tree, one foot long, 4 inches wide, and 1½ inches deep, the instrument used being the native adze. A gouge chisel is then driven into the tree just below the botton of this incision, into the curved cut thus made a strip of zinc 5 inches long and 1½ inches wide, is driven by the handle of the gouge; this forms a lip which guides the resin into the pot placed below to receive it. This vessel is supported by a nail, and a piece of string passing round and fastened to nails on either side.

The pots are now made locally of unglazed earthenware at a cost of Rs. 2-8-0 per 100, or about 5 pies each. They were at first made of zinc, but these were soon abandoned, as they cost eight annas each, and were apt to be stolen by the hillmen.

The cut or blaze is freshened every eight days by taking off a thin strip at the top, ¼ inch thick and about 8 or 9 inches long; we examined several of these cuts immediately after they had been freshened and found the resin oozing out in bead like drops from 45 and 18 annual rings respectively. In the Chir pine, we believe, that the whole of the sapwood is capable of producing resin, but there are reasons for not making the cuts deeper, one being that it would require a very long time for a deep cut to heal over. The trees are frequently of large girth, and two cuts are made on each tree. At the end of the working season, the cut is about 2 feet high, and at the beginning of the following season, the pot is removed to the top of the old blaze and the work continued as before. Some trees are now being tapped, as an experiment, for the fourth and fifth year, but generally speaking, three years is considered sufficient for one continuous tapping. The tree is then abandoned and allowed rest.

The pots are covered with pieces of Chir bark to prevent foreign matter falling into them, but these are frequently blown off and we noticed that much of the resin was mixed with pine needles, chips, bits of bark, &c., which has to be strained out afterwards.

The resin is collected every eight days by a distinct set of men and taken to Kathiyan where it is stored in wooden tanks. From time to time it is packed and soldered up in old kerosine oil tins, and then sent on mules to Chakrata, on its way to Dehra where it is distilled.

During the season of 1892, the outturn of resin was 594 maunds and the cost of collection and carriage as far as Chakrata was as follows :—

(1)	Tapping and collecting ...	Rs. 722
(2)	Purchase of material	„ 21
(3)	Soldering tins	„ 52
(4)	Carriage to Chakrata	„ 76
		Rs. 871

Or about Rs. 1-7-5 per maund, a sensible reduction on the cost of the previous year.

The trees yielded 4⅝ seers each in Bagur block, and 5¼ seers in Karun.

The future of this industry depends on the sale of the turpentine. At present the whole of the resin or colophony is taken by the Soap Works at Meerut, and about two-thirds of the turpentine can be sold. Whenever the annual outturn of the turpentine can be disposed of, the tapping of the pines can be conducted on a larger scale. (Since the above was written, arrangements have been made for the sale of the turpentine to the N. W. Railway and it is almost certain that this industry will be largely developed.

KATHIYAN TO THADIAR.

17th May—On this march, we proceeded along the Tons road, many portions of which are interesting from an engineering point of view. The average gradient of the road from Kathiyan down to Dharmigadh is 6° to 8° and we inspected the various bridges, retaining walls and railings, and witnessed some blasting of rocks to widen the road. Blasting is done by contract, the holes being made at a cost of 4 to 6 annas per foot, which includes everything, except the cost of the powder. As a rule, one chittack of powder is used for every 12 inches depth of hole, but the amount varies slightly with the hardness of the rock.

The student's attention was also called to the excellent natural reproduction in the lower portion of the Chir forests in the Tons valley, which had resulted owing to the area being protected from fire since 1885.

The Tons Chir Forests.

The following account of these forests is taken from the Journals of 1888 and 1891 combined.

Various fellings have been made from time to time in the Tons chir forests, the trees being marked by the Ranger or Divisional Officer and sold standing to contractors, who saw them up into scantlings and float them down to Dakhpathar in the Western Dún. They pay about Rs. 5-4 for a tree over six feet in girth.

In 1878 it was proposed that sleepers of the chir pine should be impregnated with creosote or with metallic salts, and that works for this object should be set up on the Jumna. A report was prepared by Dr. Warth on the subject of impregnation, (1) and the chir forests were inspected and surveyed by Mr. Smythies and a report on them submitted (2). But the railway Companies preferred deodar and the matter fell through. The question may, however, crop up again, when the deodar forests outside British territory have been exhausted and then the Tons chir forests will become important. As it is, there is such a great demand for chir timber that 4,000 first class trees could be sold every year. In 1879 it was estimated that there were nearly 200,000 chir trees above 6½ feet girth on the left bank on the Tons above Chattra, but perhaps one-quarter to one-half were too heavily branched to yield sleepers or Karis.

In 1881 three hundred chir trees were sold to Mr. Spread for for Rs. 3 each. These trees were 120 feet high and 12 feet girth, and were situated in the Khunigadh, close to the banks of the Tons; 4 or 5 trees per acre were cut. Mr. Spread's venture was not a financial success, the resulting natural reproduction was however very good.

No more Chir trees were sold until 1887, when 300 trees were sold for Rs. 6 each from the same area, leaving about 8 trees per acre on the area. The trees were cut from this area as the young seedlings which had come up required more light.

In 1891, 800 trees with an average girth of 7 to 8 feet and at a distance of two miles from the river, were sold for Rs. 6-8 per tree. A market for Chir wood has been made, and the wood is in great demand in the Punjab.

The trees are converted into karis 11 feet long by 5″ × 4″ or 5″ × 5″, which are carried to the banks of the Tons and there stacked. The stacks are covered with mud to prevent the karis cracking and to allow them to season. The karis are floated down the Tons after the rains.

Besides the trees sold standing, trees are also converted departmentally, and the resulting karis sold by auction in September on banks of the Tons. The Chir forests Working Plan provides

(1). Memorandum on the establishment of a Factory for impregnating pine sleepers from the North-Western Himalaya with metallic salts (Government Central Branch Press, Simla, No. 484R A. and C.)

(2). The Chir forests on the left bank of Tons river situated in Tehri Garhwal and Jaunsar Bawar, dated 25th August, 1897.

that a certain area annually shall be worked departmentally, the number of trees to be removed annually being left to the discretion of the Divisional Officer.

In 1889-90 four hundred and thirteen trees of various sizes were cut on and above the Tons road fireline, as it was found that the dry needles which fall annually were a great source of danger in the fire season.

In the earlier fellings of 1881, the following measurements have been recorded as to the reproduction :—

			Ft.	In.
1886	52	seedlings, average height ...	2	9½
1888	72	„ „ „ ...	5	5
1891	250	„ „ „ ...	7	2
1892	303	„ „ „ ...	9	5

The girth of a mature tree measured was 7 feet 7 inches and the average distance from tree to tree, before the felling took place was 34 feet, giving roughly 40 trees per acre.

In the older fellings of 1881, a final felling could now be made as the ground is completely stocked with seedlings, and young chir requires an unlimited supply ot light. The contrast between these fire-protected forests and those annually burnt, as along the Dharmigadh valley, is most striking. There is very little undergrowth in these forests, with the exception of sandan (*Ougeinia dalbergioides*) but the grass is long and thick, and fire-protection exceedingly difficult, as the grass is ready to burn in November. The fire season is therefore eight months long. The chir seedling has a wonderful power of shooting up again when burnt to the ground, and on the fire lines and other areas burnt, we noticed many instances of young shoots springing up from the collum buds. During this process, which goes on year after year, the root becomes thicker and stronger, and eventually the young seedling may become strong enough to resist a fire ; but there can be no question that many years' production is lost, and there is a chance of unsoundness at the base. Of all conifers with which we are acquainted, chir possesses the greatest power of withstanding fire.

The fireline along the Tons road is about 50 feet wide, and the upper limit is a two foot made path, from which the grass is burnt downwards when sufficiently dry. In order to lessen the danger of fire spreading in May and June when the needles of the pine fall, a belt of about 100 feet wide above the fireline, has been completely cleared of the trees and in consequence there is excellent natural reproduction on this belt, the young seedlings being now 6 to 8 feet high. These, in their turn, will shed needles, and they may have to be cut down in a similar manner. It is essential to keep the fireline quite cleared of all inflammable matter during the entire season.

The valley of the Tons is rich botanical ground for the forest student, and many interesting species may be collected between Thadiar and the Khunigadh : among others *Cinnamomum Tamala* which yields the "dalchini" of the bazárs.

Fuel Supply Works in Naini Tal.

Readers who may have resided in Naini Tal will be interested in a revised scheme proposed by the Conservator, Central Circle, in July, 1893, for the supply of fuel by Departmental Agency to the Naini Tal Settlement, which received the sanction of Government in September and comes into force on the 1st January, 1894.

For some years the firewood supply of Naini Tal was met by the collection by the *Jhampan* bearers of the residents—of dry wood which had accumulated in the neighbouring forests—who were licensed for the purpose at eight annas a head a month. In due course, the supply of dry wood was exhausted, and the *Jhampanies*, with licenses to collect what was not to be found, began to cut green wood, and continued to do so in spite of numerous prosecutions and punishments. Then certain trees were girdled and others cut in order to provide dry wood, and eventually the system of providing green wood in licenses at one rupee a head a month was sanctioned by Government and came into force during the current season.

The Conservator, after carefully going into the question, represented that this system was as faulty and wanting in permanency as were the earlier arrangements, and that it, too, must come to an end, and in the meantime result in the destruction of the forests within easy reach of the Settlement, upon which the *jhampanies*, consistently with their other duties, can draw. This conclusion was based on the following figures :—

Monthly wood tickets as issued at present are as follows :—

1st April to 31st October	...	...	3,000
1st November to 31st March	...	...	300
	Total	..	3,300

It was estimated that each ticket holder brings in 25 maunds a month, of which 10-12 maunds are delivered to his employer, a little is used, and 10-12 maunds are sold at a not lower rate than 4 annas a maund. The result is that 82,500 maunds of fire wood are removed from the forests, the resident obtains 10-12 maunds for a rupee, and the jhampani profits to the extent of Rs. 2-8 to Rs. 3 per month by the sale of wood. With regard to the quantity of fire-wood available, the Conservator worked out the areas set apart within the radius to which *jhampanies* can go, and found that they correspond roughly to 1,600 acres of completely stocked forest. The blanks could only be estimated and an arbitrary co-efficient of density applied, which was either taken from the Working Plan, or adopted from Conservator's own inspection of the areas,

but the result may be accepted, that at least five times the area in its present condition, would be necessary to meet the demand which might probably be taken at a round figure of 100,000 maunds, rather than at 82,500.

It was thought that the residents of Naini Tal could not reasonably expect to obtain their wood, at the sacrifice of all the adjoining forest, at 10 and 12 maunds to the rupee, while the same wood was being sold by their *jhampanies* in the Bazar, and even in their own compounds, at 4 maunds, and should a supply of good, dry wood be made available for them at about that rate, the Conservator was of opinion that they could have no just ground for complaint.

The pay of the *jhampani* is, at present, five rupees a month; but by the benevolent custom which has grown up and enabled him not only to supply his master with cheap fire-wood, but also to retail at his own price some 40,000 maunds of wood (his only title to which being that he has cut and carried it), he supplements his pay by 2½ or 3 rupees a month, and thus receives a total of 7½ or 8 rupees a month. Now, it cannot be denied that this is an extravagant price, and in excess of that ruling in other Hill stations, and when it is considered that it is paid by the gradual and certain denudation of the forests in the neighbourhood, the Conservator had no doubt it would be admitted that the time had come to make other arrangements and to bring the *jhampanies*' pay to a level with that of other unskilled labourers.

The proposal submitted by the Conservator was to abolish the system of issuing tickets and to establish four or five depôts at which the Forest Department should undertake to have on sale the requisite 100,000 maunds of fire-wood at Rs. 20 per 100 maunds. This would enable the Department to fell in suitable places at a distance beyond the radius within which the *jhampani* could go for his load and so to assure a constant supply and the maintenance of the forest.

The effect of this would be to (1) take away the *jhampanies*' perquisite in wood and so reduce his salary to Rs. 5, and (2) to give an ample supply of dry wood of good quality at about, or somewhat less than the rates now prevailing in the settlement, and residents could not reasonably complain of such a rate.

The old system was very tersely described by our friend and colleague, Mr. Fernandez, in his Working Plan report "as a premium for the European residents to entertain an army of liveried *jhampanies*," and its abolition is distinctly a step that should have been taken long ago.

Forest Administration in Oudh.

Given a long narrow strip of forest bounded on all sides with cultivation; burden the area with concessions in free produce limited to all villages within three miles of forest boundary but otherwise undefined; permit the concessionists to remove the free produce in such form and from such localities as best suits them; allow their cattle in any number to roam through the area, and what will be the condition of that forest after 25 years? The local administration of the Province of Oudh conceived in 1865 the idea that it was necessary to encourage cultivation and recoup the tenantry for the loss in crops and health consequent on proximity to the forests, by making certain concessions to the inhabitants of the country in the neighbourhood of State Reserves; and by executive order, ruled that all villages within 3 miles of the forest boundary might receive free produce for domestic and agricultural requirements and graze their cattle at preferential rates. For eleven years these orders remained in force without registration of villages, without definition of the amount of free grants or of the number of cattle to be grazed, and without allotment of locality for the exercise of the privileges; that is to say, that any village whose boundary fell within the limit of 3 miles from State Forests, might graze any number of cattle and remove any amount of produce from any part of the area! In 1876 a special commission was appointed to enquire into rights and privileges in the Oudh Forests and generally into their management in relation to the agricultural necessities of the Province. This commission recommended the continuance of concessions granted in 1865 but suggested alterations in the method of the exercise of these grants, pointing out that a register of 3-mile villages should be drawn up, and that concessions of free produce should be defined on the basis of the number of 1st, 2nd and 3rd class houses in each village. The Local Government ordered the registration of villages but found that the definition of concessions was unnecessary and in consequence, the annihilation of such forests where the burden imposed was excessive, continued.

In the years that followed, successive Forest Officers reported on the state of the Bhinga forests of the Bahraich Division; that the soil was utterly impoverished and incapable of allowing reproduction to proceed; that the young growth was being destroyed by the unlimited extraction of poles by concessionists, that the vast herds of cattle, averaging 2 to every 1½ acres, prevented the growth of any grass or shrub; and that the standing crop of trees of the upper age classes was drying up or decaying for want of nourishment. Little by little the closure to cattle of a portion of the area was permitted by Government and the soil in these areas speedily responded to the advantages afforded, by becoming covered, first with grass, and then with a good undergrowth of inferior species, amongst which, however,

no sal seedlings were visible. The closure was, however, only partial. The undefined liberality of Government had brought about a state of affairs as unpleasant as unexpected. Cultivation had not, as was originally intended, increased; but the attractions of cheap grazing and free produce had created a class of cattle breeders in the neighbourhood of the forest who systematically evaded the payment of fees; and who owned, besides an immense number of domestic cattle, large herds of wild cattle whose progress through the forest was uncontrolled and from whose depredations neither the closed forest nor the cultivated area was free, moreover the closure of a percentage of the forest drove the concessionists, in their search for free produce, in still greater numbers, to the now restricted open area, and it seemed as if it was hopeless to continue to contend against these adverse conditions, and that there was no alternative but to acquiesce in the destruction of the forest over at least two thirds of the area of the Range. Such was the melancholy outlook in 1893 when the compilation of a series of Working Plans for the forests of the Bahraich Division was in contemplation, and the proposals for the working of the forests of the Bhinga Range were met by the Inspector General of Forests with the objection that no working of any forest in which undefined privileges existed could be sanctioned; namely, that if the demand on the area in grazing and produce was not fixed, it would be impossible to make any proposals for its working during a term of years which could be of value. The self-evident justice of this argument was, of course, accepted by the Local Government, who approved of the principle that Government may extend their liberality in concessions to any extent within the annual yield of any forest but not to such an extent as to involve its deterioration or destruction and after due enquiry and consultation the following orders were issued.

I. That the number of cattle admitted to the privilege of preferential grazing should be limited to 4 bulls and 4 cows for every 10 pacca bighas of land cultivated within the area of a 3-mile village.

II. That the amount of free produce should be limited to the amount required for the upkeep of the present number of 1st, 2nd and 3rd class houses in each 3-mile village; and for agricultural implements to an amount also based on the cultivated area of that village.

III. That one acre per head should be allowed for the grazing of privileged cattle and the rest of the forest be closed to grazing with power to alternate open and closed areas in future years.

IV. That free produce would be given under the supervision of the Department, and as the Department might direct, from any forest within 8 miles of a privileged village, thus permitting utilization of the wastage of improvement fellings at a distance.

V. That, unless any valid objection was brought forward, the wild cattle should be captured in Kheddahs and sold at once to persons residing at a distance from the forest.

Twenty eight years have elapsed since the grant of undefined concessions in 1865, and sixteen since the commission appointed by government advised the definition of these concessions. The present Government has stepped in to stay the destruction, already nearly complete, of a large area of State forests; but the harm done in 28 years of unrestricted felling and grazing will not be rectified in a day. Twenty or perhaps thirty years hence, the forests of the Bhinga range will show a richer soil and a promising advance growth, and future Foresters will hardly realize to what a parlous state the area had been brought in 1893, owing solely to the omission to define the *amount of the* concessions granted and the method of enjoying them.

O. O.

Fire Protection in the Landes of Gascony.

The text of a Bill, which has recently been introduced into the French Senate with a view to organizing fire-protection in the Departments of the Gironde and the Landes, appears in a late number of the *Révue des Eaux et Forêts*. We give an abstract of the proposed law which may interest our readers.

After specifying the territorial limits to which the Bill relates, it is laid down that the kindling of fire shall be subject to administive rules sanctioned by the *Conseil d'Etat*. Article 3 provides that a person infringing any of the aforesaid rules shall be punished with fine varying from 20 to 500 francs, and may, in addition, be imprisoned for a period not exceeding five days. If the offender has previously been punished for a like offence, he may be imprisoned for from 3 months to 2 years; and the responsibility of parents and masters for acts by minors or workmen is enforced. By Art. 4, forest guards, whether State or Communal, and any rural police officer may take cognizance of offences under the law. The most important portion of the Bill is that relating to fire-traces. Art. 5 provides that every owner of forest or *land* which has not been completely cleared of brushwood or dry timber, may be called upon by the owner of an adjoining estate of the same description, to open and maintain in good order his share of a common fire-line running along the dividing boundary. The width of this trace will be fixed by the proprietors or, if they cannot agree, by the Justice of the Peace, after consulting the Conservator.

By Art. 6 it is proposed to render obligatory the clearing of fire-lines, 20 metres broad, along every line of railway open for traffic, expenses being defrayed equally by the companies and the adjacent proprietors. The Bill also provides for the speedy preparation of a general scheme of fire-lines of public utility and lays upon the *Maire*, or the forest officials, as the case may be, the duty of directing fire-protection measures, especially when it is necessary to have recourse to counter-firing.

Tour of the Coopers Hill Students in Germany.

The following account of the tour made by the Senior Forest Students from Cooper's Hill in the German Forests, may be interesting to some of your readers.

The tour was conducted under the able guidance of Dr. Schlich and the students were accompanied by Messrs. Reuther, E. Carr and Copeland of the Indian Forest Service.

We assembled at Frankfort on the Main at the end of April and on Monday, May 1st, accompanied by Forstmeister Henschell, started work in the forest belonging to this town. Sylviculture and valuation surveys occupied our time. We were introduced to the combination of agriculture with sylviculture. The system was in very general use a few years ago but is now only carried on in favourable localities, *i.e.*, in those free from severe frosts.

On May 5th we arrived at the University town of Giessen; here several instructive days were spent in the company of Dr. Hesse, who showed us, amongst other things, some experimental plots of Oak, Beech and Spruce, where different degrees of thinning were being tested, also a very elaborate nursery and a fine museum.

The Spessart Mountains, Bavaria, were next visited and we were here joined for a few days by Sir D. Brandis. The Spessart is a hilly tract of country, bounded on the West, South and South East by the River Main. It is divided into 12 Forest Ranges, four of which, Rothenbach, Rohrburn, Lohr, Waldaschaff, we examined from a sylvicultural point of view; the expeditions being conducted by Sir D. Brandis, who knows this part of Germany very well. Some magnificent oak and beech woods were seen here, the natural regeneration of the latter being so powerful that the former has to be protected against it when young. On Sir Dietrich's departure we were divided into parties each making a description of a certain compartment. A thinning was also made here.

On our way to the Saxon Forests we stayed a day or two at Bamberg. The woods here have suffered severely from very bad insect attacks and various interesting methods of prevention have been undertaken.

Schwarzenberg, Saxony, was reached on May 24th. The history of the Saxon Forests is interesting. At the beginning of the century, there was no Forest Conservancy at all. Rights of all sorts existed and the forests were in a deplorable state. In 1832 a law was passed empowering forest proprietors to demand a commutation of the rights which badly affected their lands. At present the management is excellent, as is shown by the fact that their revenue, after deducting *all* expenses = 41 marks per hectare. Insects give great trouble in these woods and owing to the attacks of *Hylobens abietis*, it is impossible to make large cuttings in any one spot. Great ingenuity is shown in the formation and position of the cutting series so as to reduce this danger to a minimum.

On May 31st we went over the Fichtelberg in a snow storm and saw the effect of elevation on tree growth, and then had a passing glance at Austrian Forestry, on our way to Carlsbad. Here we were given a three days' holiday, re-assembling at Heidelberg on June 4th. From this well-known town we went to Vierheim, Hesse Darmstadt. The first attempt to employ agriculture for sylvicultural purposes was made here in 1810. It is now given up, however, the Scotch Pine being used as a nurse for the oak. The nursery here is curious. It is made under a shelter wood of Scotch Pine. These are left not only to shelter the beech seedlings but also that larger timber may be obtained.

Our tour in the Black Forest began at Baden-Baden on June 8th, sylviculture being the chief point of interest in the woods here.

At Herrenwies, which we reached on June 13th, a large amount of work was got through. After a tour in the woods, the parties made a description of three compartments and these, with some others included by Dr. Schlich, were formed into a neat and condensed working plan. One of the forest districts here, Forbach I, next to the Herrenwies dirtrict, belongs to several villages and a church. It is managed by the State Forest Officer. From the proceeds of these communal forests, roads, school houses, &c., are built and all the expenses of the municipalities are defrayed, so that there are no local rates, taxes or school fees to be paid, certainly an ideal state to live in, especially as, in addition, a sum of money is received by each villager. From here we travelled by Schönmunzach and Fremdenstadt to Kippenheim, the home of a fine coppice with standards forest. Owing to its situation, in the fertile Rhine plain, the coppice at the age of 30 years attains a height of 30 feet which is exceptional for these climes, I believe. From here Staufen, E. Black Forest, and Shönau were visited, the latter by tramping over the Belchen. The object of the latter was to notice the change in vegetation. This was most marked, beginning at the foot with fine well-grown forests and ending in a grassy mound (1415 metres.) On July 5th we left Schönau for Todtmoos, South Schwarzwald. In the 10 days we spent here, we built a charcoal kiln and saw it burnt and opened ; made a thinning and saw some heavy timber let down a steep slope. We also visited several Black Forest cottages and saw the manner in which the wood is worked up by the peasants in the manufacture of tubs, baskets, brushes, boxes, kitchen utensils, &c. The facility with which they manipulated spruce wood was wonderful to watch. Of course, it broke, instead of bending, in our hands.

On July 13th we proceeded to St. Blasien where, at their Serene Highnesses' request, we were presented to the Grand Duke and Duchess of Baden.

Zurich, reached on July 16th was the last place visited. Here, under the able guidance of Forstmeister Meister, many things of interest to the forester were pointed out in the Siewald. Timber slides

and tramways were seen here in full working order, all the produce of the forests being worked up by the Forstmeister in his own factories before any sale is attempted. The machine for chopping up wood, turning out hatchet and broom handles, &c., were very ingenious and, in some cases, extremely simple.

This brought a most instructive and, thanks to the perfect management of Dr. Schlich, an extremely pleasant tour to a close.

E. P. S.

Forest Fires.

The occupants of a cyclone-pit can, says a writer in *Lippincott's Magazine* (U. S. A.) defy the fury of the storm, and Professor Herkimer, of Lima, Peru, has devised half a dozen different models of dwelling-houses which an earthquake may shake, but never break, while the conflagration of a large pine forest reduces all living things to the alternative of death or instant flight. During the Saginaw Bay fires of 1875, Squire Wirth, of Gladwin County, had surrounded his farm with a clearing from sixty to eighty yards wide, in the hope of saving at least the main building, but the conflagration overleaped that barrier at the first attempt; the dwelling-house, barn, and several stables caught fire almost simultaneously from a shower of flying sparks that swept ahead on the wings of the gale. There are plants (such as reeds and swamp-grass) that would extinguish a camp fire as effectually as a wet sponge would quench the flame of a rush-light; but the fierce heat preceding extensive woodland fires turns all vegetable products into fuel. Green leaves turn brown, saplings wrinkle and twist, the gray tassels of Spanish moss curl up and turn as black as horse-hair—all ready to blaze at the touch of the first spark. At a distance of three hundred yards from the actual flames of a forest fire near Rockwood, Tennessee, a Fahrenheit thermometer rose at once to the top of the scale—*i.e.* to 180 deg. above zero, and would have burst its tube the next minute if the experimenter, wrapped up in wet shawls, had not snatched it away in the nick of time.

"Sparks fell all around us," says an eye-witness of the recent highland fires in Northern Oregon, "and the air felt like 'a flame, though the distance to the next burning trees was about 'a quarter of a mile. I have been working in the open sunshine 'in Fresno County, California, when the thermometer stood at '108 deg. in the shade, but the temperature of that sun heat 'seemed mild compared with that of the atmosphere all around 'us, except on the east side of the house, where the night wind 'felt almost cool. My brother, who had run out to snatch a 'saddle-blanket from the fence, came back with his hands looking 'as if blistered, though he had managed to dodge the sparks. 'The heat on the west side of the fence was enough to roast the 'rosin out of a pine rail, and must have exceeded 200 degs., 'judging from the fact that the thermometer on our side porch 'had risen to 162 deg. several minutes before the rooms became 'untenable, both on account of the temperature and of the prick-'ling odour of the smoke-clouds that penetrated through every 'cranny."

The damages caused by forest fires in the course of the last twenty years in the United States and British North America, has been estimated at eight hundred million dollars, a sum

which does not include the indirect loss from the destruction of game, insect-eating birds, &c., nor from the deterioration of climatic conditions, since tree-devouring fires are both a consequence and a cause of droughts. How completely and radically the vegetable life of large districts can be destroyed by intense heat, may be inferred from the fact that in the forest provinces of Brazil, where the woods are often burnt purposely in the interest of agriculture, an entirely new flora is apt to spring up on the *quemaderos*, or "charred" lands, as a proof that the original vegetation has been utterly annihilated. In Alleghany County, Maryland, dogwood roots were found scorched to a depth of 18 inches, though the ground around the demolished tree was not more than usually porous. A little ground squirrel was found dead in its burrow of about two feet of vertical depth; another in a somewhat deeper hole was still alive but lethargised with heat or smoke. For most other animals the chances of survival are measured by the rate of speed. Instinct drives them towards the next clearings, and the proprietor of a large ploughed field gets often a chance to revise his estimate as to the animal population of an apparently uninhabited forest. Foxes, minks, woodchucks, rabbits, and weasles dart out of thickets that were supposed to harbour only lizards.

The Resin of Conifers.

The origin and properties of resin in coniferous timber have recently been investigated by Dr. H. Mayr, and he has succeeded in demonstrating several new and interesting points. The subject is treated rather fully in an article contributed by Dr. Mayr to the Zeitschrift für Forst und Jagdwesen for June, and his conclusions, some of which differ from those of previous investigators, are summarised as follows :—

1. Only in an invisible, and thus in the molecular form, in the plasma, can existing resin pass into an intercellular space. Therefore—

2. The cell wall is only permeable for resin so long as it is in process of formation.

3. All resin canal cells which subsequently belong to the permanent tissue of the wood, not resin secreting, epithelial cells, but partly store cells, as other parenchyma cells, partly secondary meristem cells (thin walled), are converted after a series of years into permanent cells ; therefore, it follows that a secretion of resin in the canals can only occur during the first year or two of the formation of the canal-carrying annual rings.

4. Finished cell-walls, whether lignified, thickened, or not, cannot be permeated by resin so long as the respective walls are saturated by water, and, as in the living tree, both sap and heartwood are always saturated, so it follows that—

5. All cell-walls of normal wood in the living tree are always free from resin.

6. All resin-holding spaces are surrounded by an impervious, continuous cell tissue, and, therefore, are completely isolated. The resin cavities are entirely closed in on all sides, and never open at the exterior in an uninjured tree.

7. There is, therefore, no spontaneous exudation of resin towards the surface ; every outflow of resin is pathological ; where, *primo aspectu*, a spontaneous outflow appears to occur, as on the buds of different conifers, a close investigation shows that it is connected with exudation into an intercellular space, or with the drying-up of the outer layers, thus in the case of the latter a pathological occurrence.

8. All resin canals of the wood stand vertically over one another, and the horizontal always arise from the vertical ; should the place of origin have become lignified with the respective year ring, then the connection between the two forms is effected where the horizontal and vertical canals occasionally cross.

9. With the conversion of sap into heartwood the resin-canals are filled up by tyloses, so that a subsequent flow of resin from the sap to the heartwood, or *vice versa* (as with the economic extraction of resin), is impossible.

10. The resin must be a bye-product in the formation of coniferin, one of the usually occurring substances in the resin-yielding conifers ; the resin does not arise from the coniferin, but simultaneously with it and starch may be considered as the raw material for the formation of both.

11. Neither by normal nor pathological causes (chemical decomposition, or fermentation through fungi) does a conversion of coniferin lignin, or cellulose (the constituents of the cell-walls), into resin occur.

12. Should a gradual diminution of the watery contents of the cell-wall occur through mechanico-pathological causes (wounds, punctures by insects, etc.), the resin partly takes the place of the water, and can, through unwounded and turgescent neighbouring wood, also fill the "lumina" of the cells. Should fresh wood remain in the ground, as, for example, the stumps of felled trees, the resin is gradually forced by the surrounding moisture into the interior of the stump Under favourable conditions as in stagnant water or bogs, the resin occurs in the rotting wood as resin-hydrate in a crystalline form.—*Gardiners' Chronicle.*

Pice Packets of Quinine.

We have received a copy of the last Cinchona Report of the Government of Bengal with samples of the pice packets of quinine which are now for sale at all Post Offices throughout the Lower Provinces.

The following extract from Dr. G. King's Report shews what has been done.

Sale of Quinine at Post-offices.—The chief event of the year has been the organization of the system by which quinine, made up in doses of five grains, is offered for sale at most of the Post-Offices within the Province of Bengal. Each dose is made up in a neat closed paper envelope, and is sold for one pice. Each packet carries the royal arms as a guarantee of genuineness, together with brief instructions in the vernacular. To encourage the Post-Office officials to push the sale of these

packets, a small commission is allowed, and considerable facility is offered for replenishing of stocks by post-masters; the parcel-rates for transmission, however, bear rather heavily on the scheme, and I trust some means of lightening them may soon be found. When the scheme was suggested last year, it very soon became obvious that one of the first conditions of success would be to find some means of making up the packets by which adulteration and loss from pilfering and careless weighment might be reduced to a minimum. It was therefore decided by Government to make this matter over to the Jail Department. The quinine is therefore made over from the factory to that department in bulk, and by prison labour it is subdivided into pice packets, 1,400 of which go to each avoirdupois pound. The Jail Department distributes these packets to the post-masters and collects the proceeds of the sales at the various Post-Offices. A dose of pure quinine is by this means put within the reach of any person within the province who has a pice to buy it with. Thus at last, after thirty years of effort, has the end been attained which the Government set before itself when the growth of the medical cinchonas was begun in British India. That end was thus expressed in an early Government resolution on the subject:—"To put the only medicine that is of any use in the cure of the commonest and most fatal of Indian diseases within the reach of the poorest." Of the provinces usually supplied with quinine from the Mungpoo Factory, Bengal is the only one into which this pice-packet system has as yet been introduced. It is believed that, should the various provinces under the Government of India adopt the system, large demands will be made on the cinchona plantation, and extended planting operations may have to be undertaken. To meet such, Government have, in addition to the land reserved in the neighbourhood of Mungpoo, a reserve on the Bhootan frontier in Engo Valley, in which ground has not yet been broken.

The Bengal Government express great satisfaction with the arrangement and note that 475lbs of quinine were thus made up into packets for sale during the year. The paper packets are small envelopes of strong paper about $2\frac{1}{2}$ by $1\frac{1}{4}$ inches and each contains 5 grains of sulphate of quinine. The price is so calculated as only just to leave to Government a very small profit on its plantation. This is shewn by the fact that while the *gross* revenue of the year was Rs. 1,17,768 the *net* revenue was only Rs 3,171. We wish every success to the new venture which ought to be a useful one for Forest Officers, for they can now carry about with them in convenient form, sufficient to meet the many demands for quinine which every forest officer who has had to serve in unhealthy regions is so well accustomed to. We hope that it will not be long before the other Local Governments of the Bengal Presidency follow the lead of Bengal in taking the matter up.

THE

INDIAN FORESTER.

Vol. XIX.] **December, 1893.** **[No. 12.**

A Tour in Jaunsar.

Thadiar Suspension Bridge.—The Tons is crossed at Thadiar by a suspension bridge, which was built by the Forest Department in 1875 at a cost of Rs. 2,864. It was repaired in 1878-79 at a cost of Rs. 503. *The following description of the bridge is taken* from the Journal of 1891:—

"The distance between the uprights is 164 feet, the uprights are 12 feet apart and 15½ feet high. The bridge itself is 7 feet wide. The two cables which support the bridge are 5 inches in girth. The suspensors are 1 inch in circumference; they are passed through the large cables to prevent them from slipping; the lower ends of the suspensors are fastened to the cross beams which carry the longitudinal beams, on which the planking rests. Five transverse beams in the middle of the bridge rest on the cables and two others are just under it.

The bridge was originally given a camber of 1 foot to allow for the stretching of the ropes. Railings are placed on either side of the bridge consisting of wooden uprights and wires stretched horizontally. The planks of the roadway are 7 feet long by 6 in. by 2 in. and planks ½ in. thick and 2 feet wide are nailed over these in the centre of the roadway where most of the traffic falls.

Three masonry abutments have been built over the anchorage of the bridge on the left bank to protect it from earth slips.

The cables are fixed to Deodar logs placed horizontally, buried in the ground and kept in position by 2 Sissu logs driven into the ground at an angle of 70 degrees over the Deodar log. The end of the cables are frayed out and nailed on to the Deodar logs."

The Wet Slide and the Sledge road.—Formerly the sleepers were conveyed to the Tons partly by means of a wet slide, partly by a sledge road. The former was totally destroyed in the great

flood of the 10th August, 1889, and not a vestige now remains. For an account of this flood, see *Indian Forester*, Vol XV, p. 293.

The following description of the wet slide, a model of which may be seen at the Forest School, may be given here for reference, although it is extremely unlikely that any more will be constructed, the sledge road having proved superior in every way :—

"The slide, which is 12,192 feet in length, was constructed during 1876-78 at a cost of Rs. 26,000, whilst up to the end of March, 1885, Rs. 7,988 have been spent on repairs. The gradient varies from 5 to 22 degrees, the best gradient being about 15 degrees, and the total fall is 1,300 feet. It consists of a trough composed of three beams, 12 feet by 13 in. by 5 in., roughly jointed and firmly wedged into block sleepers. These beams, which are of chir, have been found only to last three or four years at the longest, so that the entire slide has had to be reconstructed more than once. It would have been much cheaper in the end to have made it of deodar, as this wood lasts indefinitely in the hills, whilst chir rots in two or three years when exposed to alternations of heat and moisture. The inside measurement of the slide is 13 inches wide by 8 inches high, as it was originally constructed for the sliding of broad-gauge sleepers ; for metre-gauge sleepers, a lighter slide would suffice. There are in all eight main bridges varying from 30 to 70 feet in length, as well as several heavy rock-cuttings and retaining walls 20 to 25 feet high. The slide is worked by means of a good flow of water, which is let in from the Bagiar nala by means of troughs situated about a quarter of a mile apart, very little water being required when the gradient is of 22 degrees, but a plentiful supply of water being absolutely necessary when it is less than 18 or 20 degrees. The slide is principally worked during the rains, as there is not sufficient water available at other seasons, except during February, after the melting of the snow. With a good supply of water, a sleeper takes about ten minutes travalling down the slide, and 1,200 sleepers can be slid in one working day of 10 or 12 hours. On arrival at the Thadiar depôt on the banks of the Tons, the sleepers are thrown out of the slide by means of a kind of table provided with a slanting beam against which they strike, and they are then stacked. After the monsoon or during February, the sleepers are slid directly into the Tons, but this cannot be done during the floods. Since its completion to the end of March, 1885, 407,800 sleepers, of which 135,000 were broad-gauge, have been exported by its aid ; the saving thus effected has been estimated at Rs. 15,014."

When the slide was destroyed, it was not considered advisable to construct another owing to the great expense and difficulty in working, and a sledge road similar to the existing one in the Deota forest was made in its place. It has been fully described in Mr. Mc'A. Moir's report of 1891.

The sledge road is 7,960 feet in length and is constructed of two rows of longitudinal beams of chir pine, 10 to 12 feet long $4\frac{1}{2}$ in. by 4 in. and placed 24 in. apart. On to these beams are notched cross pieces 5 feet by 4 in. by 4 in. placed 24 in. to 33 in. apart according to the slope. In these cross pieces, which are made of rejected deodar sleepers, are cut the slots which serve as guides for the sledges. The slots are $\frac{1}{2}$ inch deep, from 6 in. to 7 in. wide, and 30 in. apart from centre to centre. The cross pieces besides being notched, are also fastened by Moru oak trenails.

Where the gradient of the sledge road is less than 6 degrees, the cross pieces are placed 24 inches apart so that the sledge rests on three cross pieces at one time ; where the gradient is more than 6 degrees the cross pieces are placed 30 inches apart and the sledge rests on 2 cross pieces only at the same time. It has been found that the sledge runs more easily on low gradients, when the cross pieces are placed closer to each other.

The sledges do not run easily unless the sledge road is quite dry. In order to decrease the friction, a mixture of soap and mustard oil is applied to the slots of the cross pieces. This is cheaper than ghee, and is nearly as effective ; the mixture is applied where required by a boy who precedes the sledges ; where the gradient is too steep, the progress of the sledge may be stopped by the application of a little sand.

On the inner side of the sledge road is a good drain so as to keep the sledge road as dry as possible. The accumulated water is taken under the sledge road in box drains where necessary. The drier the metalling in which the longitudinal beams are laid the more lasting will they be.

Moru would be more suitable than Deodar on low gradients, as its grain is smoother but it has not yet been used on account of the greater expense in cutting it up. Chir would probably be better than Deodar on the steeper gradients, as its grain is rougher than Deodar, but it is not so lasting.

The sledges are similar to those used on the Deota sledge road ; they consist of two runners made of seasoned Moru Oak placed 28 inches apart, strengthened by two or three wooden struts, and carrying six uprights, and two handles. The runners are 10 feet 8 in. by 5 in. by $1\frac{3}{4}$ in. for B. G. sleepers, and 9 in. by 5 in. by $1\frac{3}{4}$ in. for M. G. sleepers ; and when they are worn down to 2 in. they are re-soled with pieces of Moru oak. One sledge costs about Rs. 10, and carries 20 M. G. or 15 B. G. sleepers. Two men work one sledge and they make 4 to 5 journeys a day from the Chabai depôt to the head of the dry shoot ; they are paid 4 as. per sledge of M. G. sleepers, and 6 as. per sledge of B. G. Sleepers.

We inspected various bridges along the sledge road, and the students took detailed measurements of bridge No. 10, so as to reproduce a drawing to scale.

Bridge No. 1 over the rice fields is 368 ft. long, with 1 spans of variable length, supported on dry rubble stone piers.

Bridge No. 2 is supported by a huge boulder, the top of which has been blasted to receive the roadway.

Bridge No. 9 is 68 ft. long, and 57 ft. high from the bottom of the khud. It consists of one span and is supported by straining beams and struts.

Bridge No. 15 is 154 ft. long, with a gradient of 7 degrees to 8 degrees, and supported on piers and abutments. The piers are 9 feet by 7½ at the base, tapering to 6 ft. by 5 ft. at the top. There are 5 spans of about 28 feet each. To prevent shaking a T or H. shaped trestle is erected below the middle of the beams in each span.

The original cost of the Thadiar sledge road was Rs. 4,534, or about Rs. 3,000 per mile. It has been estimated that the cost of carriage of sleepers for four years on men's backs would have been Rs. 39,000, whereas the cost of construction, sledging, repairs, &c., during the same period would be about Rs. 15,500. There is thus a saving of Rs. 23,500, or nearly Rs. 6,000 a year ; this clearly shews the advantage of the sledge road over ordinary methods of carriage.

When the sleepers arrive at the end of the sledge road—the Thadiar depôt—they are stacked in heaps of 200, and in October and in November are launched into the Tons by means of the timber shoot. The following description is from the Journal of 1891 :—

"The shoot is 333 feet long. It consists of an open trough laid in an exact straight line, the gradient of the upper 234 feet is 42 degrees, that of the lower 99 feet 26 degrees. It is made of Chir pine throughout. The beams of which the trough is constructed are fixed into wooden tressle supports by means of wedges, the whole being bolted together by iron bolts ½ inch diameter.

The inside measurement of the trough is 11½ inches by 8 inches, the scantlings of which it is made being 12 ft. by 10 inches by 4 in.

The upper portion of the shoot is laid in a trench dug out for it ; the lower portion, which is removeable, is supported on strong wooden tressles. These are placed wherever the sides or bottom pieces of the trough are joined. The sides are made to break joint with the bottom piece.

The slide is kept moist, while the sleepers are being launched to decrease the friction and prevent its splintering, water being led from a neighbouring stream to the head of the shoot.

A launching platform has been constructed at the head of the shoot, and the sleepers which are brought down by the sledge road are stacked as near to the head of the shoot as possible.

The sledge road ends on a high bank of boulder and the shoot leads from this into the river Tons."

In one day, about 4,500 sleepers can be launched; in December 1892, 87,740 sleepers, of which 55,000 were M. G., were launched at a cost of Rs. 243, or nearly ½ a pie per sleeper. Some sleepers of both descriptions were launched in our presence, and they took on an average 7½ seconds to reach the stream; this is a velocity of 35 miles per hour, allowing 50 feet from the bottom of the shoot to the water.

The Deota deodar forest.—The Deota forest lies in a kind of amphitheatre, bounded by the Lambatach ridge to the west, and the Dhikari dhar to the north and east. The forest forms a portion of the area leased from the Raja of Tehri-Garhwal for Rs. 9,000 per annum, and there are 11 years of the lease yet to run. The area is 4,937 acres, about one-half of which constitutes the deodar zone; some of it, however, is situated on extremely precipitous ground, and cannot be worked.

The deodar zone in this forest is comprised between 7,000 and 9,000 feet altitude, the forest contains chir in the lower parts, and kharsu oak near the top of the ridge. Spruce, silver and moru are the companions of deodar, with maple, and horse-chestnut near streams. Where some peaks rise above 10,000 feet, as on Rikshin, specimens of *Rhododendron campanulatum* may be found; it was in flower at the time of our visit, 21st May.

The forest has been divided into 10 blocks with natural boundaries, all drained by the Bagiar stream and its feeders. Fellings began in 1876 in the Partil block to the east of the bungalow, and it took about 12 years to work round westwards through the Temple, Dopta, Jaurasi, Katatach, and Kanga blocks, when fellings began again in the Partil block.

The working plan for the leased forests embraces Deota, Bamsu, Surars, Sahlra, Noranu, Naintwar, Datmir, Lambatach, Kotigad, and Chansil, a total area of 45,198 acres; and the next forest to be worked will be Bamsu where preparations in the way of making a sledge road, and felling trees are now going on.

Deota has now been worked for 18 years and during that period 17,841 green Deodar trees have been felled, besides dry ones which may be estimated at 2,200, making the total 20,000. The outturn of sleepers, estimated in metre-guage, has been 12,00,000.

Natural reproduction has everywhere been excellent and the natural crop of deodar seedlings has been assisted by girdling operations wherever necessary, and supplemented by planting.

As a rule, nursery-raised plants have been put out and generally in plots 10 feet by 10 feet, five seedlings in one plot. The plot is entirely cleared of indigofera, grass, &c, and one plant is

put in the middle and one at each corner. This system has succeeded well in the Partil block in plantation No. 5 of 1881, where the following measurements were made in 1888 :—

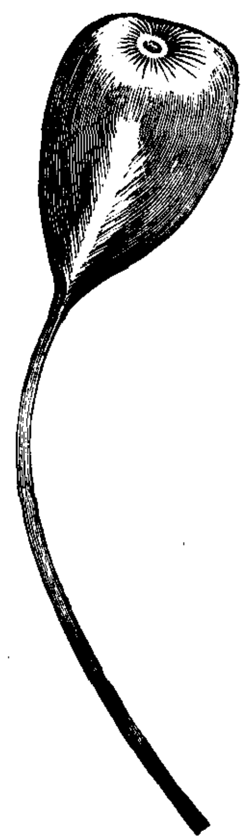
Six hundred and twelve plants had an average height of 3 feet 9 inches, but they included several younger plants, which had been put in as repairs. The average height of 12 of the tallest plants was 6 feet 4 inches. The success of this plantation is 89 per cent.

A small area planted on this system in 1882 contained 92 plots with five seedlings in each, which had an average height of 2 feet 9 inches, in 1888 :—

Girdling operations have been going on in this forest for some time past; the object being to give more light to existing seedlings and to induce more seedlings to come up. We noticed a patch of silver fir thus treated near the Deota temple, but the shade cast by the dead stems is still too great for deodar to prosper underneath. In course of time these dead trees have become rotten and are being blown down, and deodar may soon be successfully underplanted. But these gentle, moist slopes, with a westerly or north-westerly aspect, bearing a dense crop of silver fir, are by their nature not suitable for deodar, and it would be a better policy to confine our attention to slopes where we know deodar will grow well, and to girdle all oaks, spruce, fir, &c., shading existing deodar seedlings, and to plant up all the suitable blank spaces and patches of indigofera. This is being gradually done, and all we suggest here is to leave the silver fir area to the last.

Now that felling operations have come to an end in this forest, the principal point to attend to is giving the young deodar more light, as they require it, by girdling, and for this purpose it would probably be well to go round the forest once in five years. The average length of the annual shoots of deodar seedlings here is about eight inches, so in 5 years they will have grown over three feet in height.

Almost all over the areas already worked, the refuse logs and slabs still encumber the ground, seriously interfering with the reproduction; at any rate on and near the sites of the old sawing pits. It was at one time proposed to utilize this refuse wood in smelting iron, but no iron ore has been found in the neighbourhood. The villagers are allowed to remove free whatever they wish for, but this makes a very small impression on the whole area. Any manufacture which utilizes this refuse material, such as wood-pulp for paper, matches, creosote, &c., would be a great boon. But it is unlikely that any use will be found for this *debris*, and the only plan is to allow it to rot slowly on the ground, a process which will take many years.



Sclerotia from White Ants' Nest.

Sclerotia in a White Ants' nest.

A short while ago, Mr. A. E. Lowrie sent from Chanda, C. P. for determination at the Forest School, a strange black club-shaped fungoid mass which he had found in a white ants' nest. It was first referred to Mr. E. C. Cotes who suggested that the growth might be fungoid and drew attention to the remarks upon *Sclerotium stipatium* in the Dictionary of Economic Products: in that work (Vol. VI. ii. 491) Dr. Watt refers to an article in the Journal of the Agri-Horticultural Society to which we have no present access and to one by the late Dr. J. Shortt of Madras in the Journal of the Linnean Society of 1866-67 after reading which we have no doubt of its referring to the same curious growth as that received from Mr. Lowrie.

On a reference to Dr. Geobel's outlines of classification, we find *Sclerotium* defined as " a tuber-like pluri-cellular body, filled 'with nutrient material, which becomes detached when mature 'from the mycelium producing it and after remaining dormant 'for a time puts out shoots which develope into fructification. 'The most common example of a *Sclerotium* is the ergot of rye '(*Claviceps purpurea*).

Dr. Shortt's account of the growth is so interesting that we extract it from the Linnean Society's Journal as follows :—

'Scientific name—Sclerotium (Berk. et Curr).

'Indian name .—1. Púttú Manga, from púttú, a white-ant 'hill, and Manga a mango (fruit) ; literally white-ant hill mango.

'Syn.—2. Púttú Kái, from púttú, white-ant hill and Kái, 'fruit, —or, white-ant-hill fruit.

'3. Mail Manga, from mail, dry, like *sticks, leaves, etc,* 'and manga, a mango,—or, dry mango.

'I am indebted to the kindness of Daniel Hanbury, Esq., 'F. L. S., for drawing my attention to the Púttú Manga. I 'have had some experience in exploring the white-ant hills in 'the Madras district, while carrying out some experiments (the 'results of which were to be noticed in an Essay on the de-'structive effects of the White Ant), and in no instance have I 'met with the Púttú Manga ; nor is the substance, or its name, 'familiar to the natives of the Carnatic. The fact of its not 'being found in this part of India may be accounted for by the 'great dryness of the climate in this locality, and the absence of 'the moisture and heat so necessary for fungoid growths. On 'the western coast, where it rains for at least six months in the 'year, the conditions favourable for the growth of this fungus 'exist in the burrows or excavations formed by the white ants. 'The natives state that it is occasionally to be met with in dark 'crevices, and in the recesses of rocks and caves : my experience 'does not confirm this latter fact as yet ; and the specimens I 'have now the honour of submitting were all procured from the 'white-ant hill, or púttú.

'These fungoid growths are only met with in old and de- 'serted ant-hills, and frequently after the insects have become 'winged: they are found only in the peripheral and more super- 'ficial caverns, springing from their roof, occasionally from the 'floor, never from the cells occupied by the ants themselves. 'Some grow with long stalks, others are sessile; in those having 'stalks, they can, in a few, be traced beneath the soil, while the 'sessile ones seem simply to lie over the soil.

'Messrs Churrey and Hanbury are in unison with Mr. 'Berkeley in the opinion that the Púttú Manga is of fungoid 'growth; of this there can be no doubt from the habit and 'structure as also from the fact that it attains its greatest perfec- 'tion during or immediately after, the rains; and it is possible 'that further research during this particular period may tend to 'discovery of a perfect specimen, with the organs of fructifica- 'tion fully developed. The present specimens were procured in 'the Coimbatore and Malabar districts, in October 1865, and were 'removed, some *in situ* attached to the clod of earth, and others 'loose, from the interior of several white-ant hills, within the 'caverns of which some were found growing in clusters of six or 'more, hanging each by a separate stalk, and others simply over- 'lying the floors of the cells, without stalks. Those taken up 'with the clod of earth soon lost moisture, and crumbled to dust. 'These, on removal, were not quite so black in colour, and have 'shrunk considerably in size; and I should say that they are 'one-third smaller now then when taken out of the white-ant hill.

'They take on a variety of forms, being oval, oblong pyri- 'form, irregularly round, etc. The external rind is black and 'slightly wrinkled, on cutting into it, the interior is found to be 'white and pithy, and is compared by the natives to the kernel 'of a tender cocoa-nut. It is tasteless and inodorous.

'The Malayalum Vythians, who are familiar with the Púttú 'Manga believe it to be manufactured by the insects themselves, 'by a kind of accretive process, and that snakes are very fond 'of it and devour it greedily. Snake-charmers collect the Púttú 'Manga and take it round for sale, and they then give out that 'they keep a supply always on hand to feed their snakes with: 'this assertion I am much inclined to doubt.

'Others say that it is not a vegetable product, but a con- 'glomerated mass of the larvæ of white ants. It is not familiar 'to the generality of natives, and the educated among them are 'not aware of its existence; whereas it is well known to the 'rude villagers, who attribute to it poisonous qualities. The 'various accounts given of its nature and properties differ so much 'that one hardly knows what degree of reliance to place on them.

'The Vythians eagerly seek it, and use it as a remedy in 'cholera, syphilis, and a variety of other diseases. In cholera it 'is prescribed as a specific, by rubbing it up with a little water 'and fresh ginger-juice or country arrack; and the dose is re- 'peated after every motion or act of vomiting.

'The natives who assisted in removing the present specimens 'remarked that they are not full-grown, and that they attain 'the size of an orange during the monsoons. It is not common-'ly found in white-ant hills, but is met with in one out of every 'twenty or thirty on the western coast and Coimbatore district.

'I am indebted to my assistant Mr. W. Harvey, for seve-'ral specimens of the Púttú Manga, as well as for such informa-'tion on the subject as he could collect for me in the Coimbatore 'district."

Mr. Lowrie says that in Chanda it is called 'Patha dudhi' and that the natives have an idea that on the formation of a rainbow, the rainbow casts a shadow and this shadow falling on a white ant hill, these fungi are produced. The Sclerotium is used *medicinally for women in cases* where any *difficulty* is found during child birth.

The Camphor Industry in Formosa.

That Camphor is employed against different species of moths of the Tineidæ family in order to prevent them from laying their eggs in woollen clothing and furs and to prevent the damage that follows is known to every child in this country. But whence the Camphor comes, how it is obtained and what its other uses are, must be unknown to many, and so it may perhaps be of interest to our readers to learn from an eye witness, what it is and whence it comes, all the more that it is one of the principal forest products which is of importance to man. *What is Camphor?* Camphor with the chemical formula $C_{10}\ H_{16}O$ is an etherial oil which is found in the wood of the Camphor tree (*Camphora officinalis*) when treated so as to remove the oxygen. Its specific gravity is 0·98 it melts at 175 degrees C. and sublimes at 204 degrees, is colourless, crystalline, aromatic, rotates in pure water, burns into a strong flame and is soluble in alcohol. Besides the kind we are about to describe which is almost exclusively used in Europe, there is another kind, which has long been known in Eastern Asia, the Baros or Borneo Camphor, named after a town Baros on the North-West coast of Sumatra. This kind is obtained from the giant stems of the *Dryobalanops Camphora* especially in Sumatra and Borneo and is much used in those regions in religious and other ceremonies for incense. It comes, however, very little into the trade, because the demand in Eastern Asia is very large in proportion to the production and therefore we may leave it out of account. When we speak of camphor in these pages it must be understood that we refer to the produce of the *Camphora officinalis*. It should be mentioned however that the Baros Camphor fetches eighty times as high a price in the Chinese market as the product obtained from the Camphor tree.

Whence is Camphor obtained ? The chief countries in which it is produced are China and Japan. In Japan, it is found chiefly in the hill country on the sea coast southwards from the 30th degree of North Latitude up to the Island of Kinshin and Shikoku where the Camphor tree (Kusu-no-ki in Japanese,) adorns the evergreen subtropical forests. In China it is produced in the Central closed region, especially in the middle provinces whence the Camphor Wood chests so much in use in those regious are obtained, but the Camphor itself is hardly produced in sufficient quantity to be able to come into foreign trade. The island of Formosa, on the other hand, which is separated by the straits of Fokien from the continent and lies south of the Tropic of Cancer and measures 38,803 square kilometers, is the chief country of the production and export of Camphor. Formosa is counted politically as a part of the Chinese Province of Fokien which lies opposite it, although the Western side of the island has been practically taken away from the Chinese on account of the long continued fight with the aborigines, which is still going on. The island is divided into halves through one of its lengths by the Ta Chan mountains which run from North to South. The western half inclines to the sea in terrace-like slopes and this gives the name to the chief town Taudan, while on the eastern side, the mountains run done to the sea in steep rocks washed by the waves of the ocean. On the western side, the men of the long pigtail have since they arrived from China, two centuries ago, established themselves and driven back the wild races and the primeval forest. On broad areas the rice fields cultivated and watered with painful care are seen extending themselves and more lately the culture of the tea plant also at the cost of the primeval forest has made such progress that for some time past a large colony of Europeans has established itself in Twatutia. the chief shipping port, for the purposes of tea tasting and purchasing on favourable terms for their houses of trade. Next to the tea 'hong' the Camphor 'hong' plays the chief part in Twatutia, shewing the value of the export trade in these two products. To this place comes the camphor down from the mountains ; partly by water on the Tawsui river; partly by a road built a few years ago by English Engineers for the Chinese Government ; and partly on the broad shoulders of sturdy Chinese called 'coolies.'

In order to reach the place of production of the Camphor, one has first to travel by road for many miles into the interior, then partly on foot by narrow foot paths, partly in sedan chairs borne by coolies in country fashion up to the higher and steeper mountain passes, where the cultivation of the soil has to be fought out with greater difficulties and where the aborigines of the island, who belong to the Malay race, have withstood till now under the shade of the primeval forest the further advance of the Mongolians.

The Camphor Tree (*Camphora officinalis* or *Laurus Camphora*). Here in the luxuriant verdure of the countless varieties of the vegetation of a tropical and subtropical forest, we can recognize

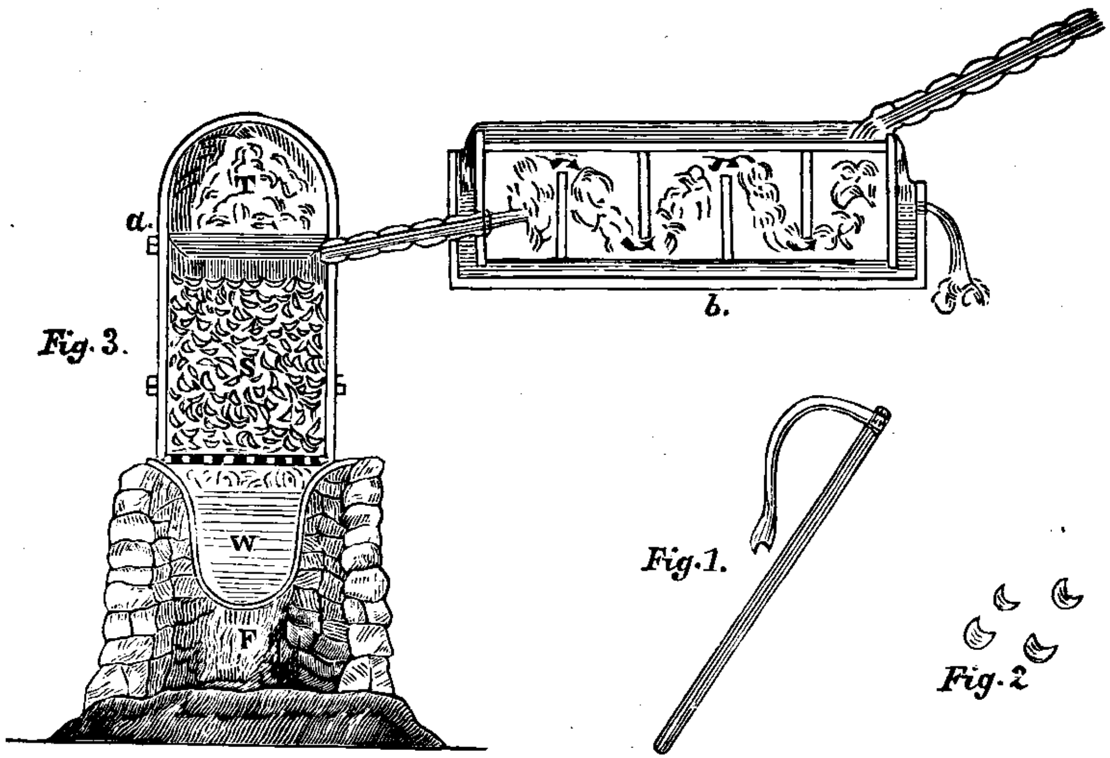


Fig. 3.

Fig. 1.

Fig. 2

among the many varieties of ferns, among the palms and tall bamboos, among the different kinds of fir and the thousand other known and unknown representatives of the flora of the country, the giants to whom those lines are devoted,—the Camphor trees. The tree belongs to the family of the Lauraceœ and its home is on the Eastern monsoon region where it is found from the 9th to the 30th degree of north latitude, on the East coat of Asia and its neighbouring islands. It reaches enormous dimensions and is considered in Japan as the king of broad leaved trees. Thus Professor Bälz of Tokio records a camphor tree having 72½ ft. in circumference at breast height and being 2,000 years old. Rein, too, gives in his excellent work on Japan, the astonishing dimensions of this tree as reaching 11½ metres in circumference and 50 metres in height.

The Camphor tree resembles our oak in its whole habit. It has the same mighty stem, with often a rough bole, the knotty branches and the irregular crown which besides in consequence of the thick foliage with dark green leathery leaves is almost impossible to see through. The interior of Formosa is still to be considered as among the richest in proportion to other lands. But in the continually growing trade in Camphor, and the wasteful kind and method of its exploitation, the stock accumulated in many centuries will soon be exhausted if nature does not in her tropical exuberance of vegetation produce sufficient regrowth, or the Chinese following the good example of the Japanese begin to start a proper system of forestry.

The exploitation of the Camphor. Here in the centre of the island, the camphor trees are felled in the management of the primeval forest, when they have 3 to 4 feet in diameter. The upper part of the bole, which gives but little camphor, generally remains lying worthless if it falls in a place which is not favourable for being taken to market, partly for consumption on the island itself, partly for export. The rootstock, however, and especially the the roots which contain much camphor are cut with specially formed axes (fig. 1) into pieces about two centimetres long, called 'chips' (fig. 2). These are then placed in one of the nearest camphor stills which are erected in the forest itself and set up in various places in the island, (fig. 3) with hot water boilers through which the camphor is extracted from the wood and precipitated in converted earthen pots fig. 3a). In Japan, the camphor stills work more cleanly and the steam is led sideways through a hollow bamboo into a condensing apparatus, over which water is led constantly in order to cool it and which at the same time affords a good means of confinement against the escape of steam. But in Formosa also, stills are worked for which the Chinese Government demands monthly a licence tax of one Mexican dollar (*3s*) and these make a better distilling apparatus and economize material.

After the camphor has been precipitated on the walls of the pot it is scraped off and brought in leaf baskets to the 'hong' of the camphor merchant. In this conditon it still contains much oil of camphor and thus it comes into export, and possibly in order to economize weight and volume, means has lately been sought for separating the oil from the camphor in presses brought from Europe. After this procedure has been gone through in the 'hong,' the camphor is usually packed in lead-lined chests and goes on its journey to different quarters. This raw camphor is sublimed again in Europe and America, and comes out, then in the form of shell shaped colourless transparent pieces of a granular crytalline structure suitable for the retail trade.

What is Camphor used for ? The best known use of camphor is still, as already explained, that of the protection of furs. For this reason also, in Eastern Asia, where furs are much worn, chests made of camphor tree wood are much in request. It is also much used in medicine for many purposes, and the fabrication of camphor oil, camphor spirits and camphor wine, absorbs a noteable percentage of the quantity imported. In industries, it serves for the preparation of blasting gelatine and celluloid which latter nowadays is employed so much for making billiard balls, stick tops, combs, knife handles, &c., and for the imitation of ebony and malachite, as well as for the various kinds of smokeless powder.

Export of Camphor from Japan and China.—The following statistics, shew the great importance of the camphor trade in Japan and China (Formosa), of late years. They are chiefly obtained from the 'Résumé Statistique de l'Empire du Japon, and the 'Statistical series of the imperial maritime customs in China.'

Export of unrefined Camphor from Japan.

1886,	32,696	cwt.	valued at	£	193,957
1887,	38,874	,,	,,	,,	236,294
1888,	27,338	,,	,,	,,	212,738
1889,	29,825	,,	,,	,,	290,796
1890,	26,782	,,	,,	,,	403,786

Export of raw Camphor from Formosa.

1889,	2,521	,,	,,	,,	,,	11,897
1890,	4,389	,,	,,	,,	,,	34,939
1891,	11,192	,,	,,	,,	,,	89,499
1892,	10,486	,,	,,	,,	,,	83,395

Import of Camphor into Germany.

1886,	cwt.	3,989
1887,	,,	6,468
1888,	,,	7,943
1889,	,,	7,070
1890,	,,	7,298
1891,	,,	11,444

while the value of 100 kilogrammes (2·4 cwt) was £14 in 1890 and £15 in 1891. So that of late years the value alone of the raw camphor imported from Germany reached £156,660, a sum which to take a forest comparison, surpasses half the revenue of the Wurtemberg state forests.

(Translated from an Article in the 'Forstlich Naturwissenschaftliche Leitschrift' for August 1893, by B. R. Freiherr von Herman).

The new draft Rules regarding Settlement and the positions of Revenue and Forest Officers.

The following Draft rules regarding the settlement and management of land taken up under the India Forest Act, and regulating the position of Revenue and Forest Officers in regard to the administration of such land, have been circulated by the Government of India for opinion and as they contain much of considerable importance to Forest Officers, we consider it right to reproduce them in our pages.

Part A.—Preamble.

1. It is important that all lands in which Government hold or claim a complete or material proprietary interest, which have not been formally demarcated and settled, and which are considered suitable for timber forest, fuel and fodder plantations, grazing reserves and the like, should be demarcated, and the rights therein definitely settled with as little delay as possible.

2. The settlement of such lands need not be immediately followed by the constitution of timber forest, plantations or grazing reserves. They can, until required for these objects, be utilized for any purpose. What is required is that they should be recorded and settled as Government property, available for any of the objects above described.

3. Although it is not contemplated by the Forest Act that lands primarily destined for agricultural purposes should be brought under the provisions of that Act, there is nothing to prevent lands settled under the Act being utilized for agriculture, whether they remain under the provisions of the Act or are disforested.

4. In the Act there is no definition of 'forest.' As in Scotland, the term may be applied to land absolutely destitute of trees. Accordingly lands taken up under Chapter* II of the Indian Forest Act, VII of 1878, and technically constituted "reserved forest," are not required under that or any other law to be planted with trees, or to be maintained for the growth trees.

* Chapter II of the Burma Forest Act, 1881.
Chapter II of the Upper Burma Forest Regulation, 1887.
Chapter II of the Madras Forest Act, 1882.
Chapter II of the Assam Forest Regulation, 1891.
Chapter II of the Berar Forest Law, 1886.
Chapter II of the British Baluchistan Forest Regula tion, 1890.
Section 3 *et seq.* of the Ajmere Forest Regulation, 1874.

5. As lands taken up under the Forest Act may be utilized for cultivation, grazing, or any other purpose, so they may be placed under any management, whether (as in the case of cultivated forest

land or grazing areas in some provinces) that of Revenue officers, or (as in the case of certain horse-runs, grass-farms, &c.) that of the Military Department, or (as in the case of forests proper, or of areas in which grazing or fuel and fodder reserves require special management and protection) that of the Forest Department.

PART B.—GENERAL RULES.

I.—All waste land considered suitable for timber forest, fuel and fodder plantations, grazing reserves and the like (1) which is the property of Government, or (2) over which the Government has proprietary rights and wherein the rights of the Government and of persons other than the *Government have not been precisely* determined and recorded, shall be taken up, dealt with, and settled under the provisions of Chapter II of the Indian Forest Act.

II.—Lands so settled will be classed under one or more of the following heads :—

- (i) Agricultural lands.
- *(ii)* Forests proper.
- (iii) Fuel and fodder reserves.
- (iv) Pasture lands.
- (v) Any combination of (ii), (iii), and (iv).
- (vi) Special purposes *(e.g.,* horse-runs).

III.—The Collector shall after consulting the District Forest Officer and the Conservator of Forests, submit for the orders of the Local Government, through the usual channel, proposals indicating for which of the purposes enumerated in Rule II it is intended to maintain the areas, when settled, whether in whole or in part.

IV.—The Local Government will when issuing orders on the proposals of the Collector, or as soon as possible thereafter, determine the agency under which each classified area shall be administered ; *but it may from time to time change such agency.*

V.—The Collector shall be responsible that all Government lands within his district are brought under settlement.

VI.—He shall submit annually to the Land Revenue authorities by whom he is controlled, for the orders of the Local Government, a schedule of unsettled lands with proposals for their settlement.

VII.—Lands brought under the Act and classed under Rule II (i) may, when required for agricultural purposes, either be retained under the operation of the Forest law or be disforested.

VIII.—If in the opinion of the Local Government they should be excluded, the previous sanction of the *Governor* General in Council must, under section* 26 of the Indian Forest Act, be obtained to their exclusion.

* Section 29 of the Burma Forest Act, 1881.
Section 27 of the Upper Burma Forest Regulation, 1887.
Section 24 of the Madras *Forest Act, 1882.*
Section 28 of the Assam Forest Regulation, 1891.
Section 11 of the Berar Forest Law, 1886.
Section 10 of the British Baluchistan Forest Regulation, 1890.

IX.—The Collector shall be responsible that the records of each settlement in his district are complete, and that they contain the following entries ;—

(*a*) A correct boundary register.

(*b*) Private rights admitted and settled under section 13 † *et seq.* of the Indian Forest Act, with such remarks regarding their limitation, commutation and extinction as the case may require.

† Section 13 of the Burma Forest Act, 1881.
Section 11 of the Upper Burma Forest Regulation, 1887.
Section 11 of the Madras Forest Act, 1882.
Section 11 of the Assam Forest Regulation, 1891.
Section 10 of the Berar Forest Law. 1886.
Section 9 of the British Baluchistan Regulation, 1890.
Section 4 of the Ajmere Forest Regulation, 1874.

(*c*) Rights granted by the Local Government under section 22‡ of the Indian Forest Act, with the necessary particulars as regards duration, limitation, and other conditions.

‡ Section 22 of the Burma Forest Act, 1881.
Section 20 of the Upper Burma Forest Regulation, 1887.
Section 18 of the Madras Forest Act, 1882.
Section 21 of the Assam Forest Regulation, 1898.
Section 6 of the Berar Forest Law, 1886.
Section 5 of the British Baluchistan Forest Regulation, 1890.

(*d*) Temporary concessions, changeable or terminable at the will of the Local Government, granted under rules made by Government under section 25* of the Indian Forest Act.

* Section 27 (*a*) of the Burma Forest Act, 1881.
Section 25 (*b*) of the Upper Burma Forest Regulation, 1887.
Section 21 of the Madras Forest Act, 1882.
Section 26 (*d*) of the Assam Forest Regulation 1891.
Section 10 (*a*) of the Berar Forest Law, 1886.
Section 9 (*a*) of the British Baluchistan Forest Regulation, 1890.

(*e*) Standing orders issued under section 25 of the Indian Forest Act for the permission of certain specific acts.

X.—The Divisional Forest Officer may at any stage of the operations submit to the Collector any proposal or suggestion relating to the classification of land or to settlements.

XI.—The Conservator may submit to the Local Government (through the proper channel) a report on the settlements in his circle or in any particular district.

XII.—In determining the agency under Rule IV, consideration should be given to the fact that the forest administration forms an integral part of the Revenue system of the country and that the forest staff provides the most convenient agency, under the control of the Revenue authorities, for the executive management not only of forests proper and of fodder and fuel reserves, but also of all Government lands in which these classes are intermixed with pasture lands, as well as, in many classes, of pasture lands which include no forests proper.

Circular Resolution No. $\frac{17}{105}$ (Agricultural), dated 15th July, 1891.

XIII.—Every settled area must be managed in accordance with a systematic and *pre-considered working-plan, deviations* from which should take place only under proper sanction.

XIV.—The scheme of management of each settled area should, so far as legal and political conditions permit, be based on all facts and influences upon which the most rational and profitable treatment depends. The collection, however, of the necessary data takes time, and all working-plans will therefore at present be divided into—

(*a*) *Regular working plans*—based on an efficient and methodical enquiry and consideration of all existing facts which may materially influence the manner of treatment.

(*b*) *Provisional working plans*—based on such data as may be available or can be collected without delay.

XV.—The regular working-plans must aim at a permanent treatment of the settled areas, and will be framed on a general scheme, which must, otherwise than in exceptional circumstances and for exceptional reasons, be permanently maintained: provided that detailed prescriptions for the intermediate treatment, necessary to bring the land into the ultimate and permanent condition aimed at, may be made for such limited terms of years as may be considered necessary.

Provisional working-plans (which may extend for one or more years) are only intended to be used as 'make-shifts' until sufficient data have been collected for the preparation of regular working-plans.

XVI.—The Collector will, with reference to Rule II, be responsible for the preparation of working-plans in the case both of lands of class (i) and of those lands in classes (ii), (iii), (iv), and (v) which are not under the executive management of the Forest Department. In the case of lands of class (vi), the appropriate special Department is responsible.

PART C.—SPECIAL RULES RELATING TO LANDS UNDER THE EXECUTIVE MANAGEMENT OF THE FOREST DEPARTMENT.

Preparation of Working-plans.

XVII.—The following rules are prescribed for the preparation of Working-Plans :—

(*a*) The Divisional Forest Officer shall submit to the Collector, not later than six months before the beginning of the forest year, a report containing a list of all areas under his control. He shall in his report—

(*1*) *as regards those areas for which regular working-plans are in operation*, shortly state what works will be carried out under the prescriptions of such plans in the year following ;

(*2*) *as regards areas managed according to provisional working-plans*, mention what works are provided for the ensuing year ;

(3) *for areas for which no regular or provisional working-plans are provided for the ensuing year,* make proposals, after due consideration of the possibility and the requirements of each area, for provisional working-plans, which shall contain his recommendations as regards fire-protection, closure against or regulation of grazing, and works of sylviculture, forest improvement and the like, and the term for which (*i.e.*, whether for one or more years) it shall be in operation.

(*b*) The Divisional Forest Officer should, either when he forwards the report required by clause (*a*) of this Rule, or at any other convenient opportunity, submit from time to time, *in respect to any areas for which no regular working-plans exist*, provisional proposals for the preparation of regular working-plans, stating whether he is in a position to compile the plans himself, and noting the assistance he may require for this purpose, or recommending that the work should be undertaken by special agency.

(*c*) The Collector shall, on receipt of the report prescribed under clause (*a*) above, forward without delay to the Conservator of Forests sections (1) and (2) thereof, indicating the works to be undertaken during the following year under the provisions of existing working-plans. The Collector may retain section (3) for consideration of the provisional working-plan with special reference to the satisfaction of rightholders in regard to forest-produce; to any proposed closure against grazing; to the withdrawal of privileges which Government may have conceded; or to local wants in forest-produce generally. And he may, if he considers such plan open to objection in any ot these particulars, return the same with his comments to the officer from whom it was received, for alteration in accordance with any directions he may make. In the event of such directions being considered by the Divisional Forest Officer to be beyond the 'possibility' of the forest in question, *i.e.*, to be incompatible with its maintenance and improvement, the case will be referred to the Conservator through the Collector. If the Conservator and the Collector, after such consultation as may be necessary, are unable to agree as to the treatment of the forest, the case will be referred to higher authority, and if necessary to Government.

(*d*) Provisional plans approved by the Collector shall be forwarded, within one month of their receipt, to the Conservator, who may, if he concurs, sanction them. In cases where the Collector and the Conservator

differ in regard to the applicability of any provision in a provisional working-plan, and when the difference cannot be removed by mutual references, the question shall be submitted to the higher Revenue authority, who shall endeavour to settle it with the Conservator, and, if unable to do so, lay it before Government for orders, informing the Conservator that he has done so.

(*e*) The Collector, on receiving provisional proposals for the preparation of working-plans under clause (*b*) of this rule, shall submit them with his comments to the higher Revenue authority, who will forward them to the Conservator for further action.

(*f*) Except as provided in Rule XVI, the Conservator is responsible that regular working-plans are prepared as soon as possible for all reserved forests in his Circle. He may either take the initiative in drawing up the plans, or may take action on the provisional proposals submitted by the divisional officers as above. In either case he will be responsible for the soundness, on all technical points, of the provisions of the working-plans, and for the manner in which they are framed.

(*g*) Every working-plan shall, after it has been framed or scrutinized by the Conservator, be finally examined by the Collector with special reference to the satisfaction of right-holders in regard to forest produce; to any proposed closure against grazing; to the withdrawal of privileges which Government may have conceded; and to the requirements of the adjacent population generally. It shall then be submitted, through the superior Revenue authority, to the Local Government for sanction. In cases where the Collector and the Conservator differ in regard to the practicability of any provision in a working-plan, and where consultation or mutual references fail to settle the question, the views of both officers shall be submitted to Government with the opinion of the superior Revenue authority.

(*h*) In the Bengal Presidency, all regular working-plans are submitted to the Local Government through the Inspector-General of Forests, who scrutinizes them and lays them before Government with his opinion.

Deviations from Working Plans.

XVIII.—For the regulation of unavoidable or desirable deviations from the prescriptions of working-plans, the following rules are prescribed :—

(a) The Divisional Forest Officer is responsible that proposals for any unavoidable or suggested deviations from sanctioned working-plans are, as soon as feasible, reported to the Collector, so that the necessary sanction thereto may without delay be given by him, or may be obtained from competent authority. Particulars of such sanction shall be entered in the Control books prescribed under the Forest Code.

(b) The Collector may sanction, on his own authority, any deviations from working-plans, regular or provisional, which do not involve either utilization* of forest produce in excess of prescription, or diminution in the extent of forest protected from fire, or of forest closed to grazing or browsing. Such deviations require the sanction of the Local Government. He shall report to the Conservator, for information and note, any sanction which he has given under this rule.

(c) The Collector shall forward any such proposals, which it is not within his own power to sanction, direct to the Conservator if the interests of the people are not materially affected, and through the superior Revenue authority to the Conservator if they are so affected.

(d) In cases where the Divisional Forest Officer has not, on his own motion, submitted proposals for necessary or desirable deviations, the Collector may, if he thinks fit, direct him to submit such proposals.

(e) The Conservator shall send direct to Government, for sanction, all proposals for deviations from *regular* working-plans received under clause (c) of this Rule in respect to which he agrees with the Revenue authorities. If he differs, he shall forward them through the Revenue authorities to the Local Government.

(f) The Conservator shall return, with his opinion, to the Collector all proposals for deviations from provisional working-plans received direct from the Collector under clause (c) of this rule. If he agrees with the Collector, the proposed deviation may be carried out. If he does not agree, the Collector will forward the case to the superior Revenue authority, who, if necessary, will submit it for the orders of Government.

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* Utilization of produce in any one year over and above the prescription for that year shall not be considered excess utilization if it is covered by unutilized balances from previous years.

(g) The Conservator shall forward to the Collector all proposals for deviations from provisional working-plans received through the superior Revenue authority under clause (c). If the Conservator agrees in the proposals, the deviation may be carried out. If he does not agree, the Collector will resubmit the case to the superior authority, who will, if necessary, submit it for the orders of Government.

(h) Particulars of all sanctioned deviations shall be entered in the Control books both of the Divisional Officer and of the Conservator.

Protection.

XIX.—To secure the protection of forests, the following rules are prescribed:—

(a) The Conservator of Forests is charged with the general control of the protection of the forests in his circle against damage by man or beast. He is required to suggest such measures as may be necessary to make protection efficient.

(b) The Collector, or other Revenue officer in independent charge of a sub-division, shall be responsible that the measures ordered for the protection of the forests in his district or sub-division are efficiently carried out, and that the subordinate Revenue and police officers of all grades render active assistance. He shall also control the working of the punitive sections of the forest law, and prevent any further interference with the people than is necessary for efficient protection.

(c) The Divisional Forest Officer, under the orders of the Collector, will be in charge of all works necessary to ensure the efficient protection of the forests.

(d) The Range-Officer is primarily responsible for the protection of the forests in his range, but is also bound to render general assistance in the protection of any forest.

(e) The Forest Officer in charge of one or more beats is primarily responsible for the protection of forests in his charge, but has also to render general assistance in the protection of any forest.

Technical management.

XX.—For the technical management of forests, the following rules are prescribed:—

(a) The Conservator of Forests shall control all practical 'working', including the disposal of forest-produce within the prescriptions of a working-plan. For this purpose he will examine the control forms. If he discovers by these means or during his tours of inspection, or from the Divisional Forest Officer's journal, any deviation for which sanction has not been obtained, he shall bring the matter to the notice of the Collector for necessary action.

(*b*) The Collector shall not, as a rule, interfere in the technical management of the State forests in his district, but shall nevertheless exercise a general supervision, and may address the Conservator on any matters regarding, and suggest any change in, the technical management.

(*c*) The Divisional Forest Officer is responsible that all works of sylviculture, forest improvement, exploitation, &c., prescribed by regular working-plans or annual plans-of-operations, are carried out completely and in a workmanlike manner; that all orders regarding fire-protection, closure against grazing, &c., are effected in the manner and to the extent laid down in the working plans and plans-of-operations; that the necessary entries to this effect are made in the Control books; and that any special works, not specified in the plan-of-operations, which he may have been ordered by competent authority to carry out, are carefully executed.

(*d*) The Range-Officer is in direct executive charge of all works of sylviculture, improvement, exploitation, and of special works which he may at any time be directed to carry out, or which may be in progress in his range, either under the prescriptions of working-plans, or under the special orders of the Divisional Forest Officer.

(*e*) The Beat-Officer is charged with the supervision of works of sylviculture, improvement and exploitation, as well as of any special works which he may have been ordered by the Range-Officer to carry out.

Finance.

XXI.—The Conservator shall be the controlling authority in all matters of finance; and, subject to the rules contained in the Departmental Code, he may address the Local Government direct on such matters.

Organization and discipline of establishments.

XXII.—As regards organization and discipline of establishments, the following rules are prescribed:—

(*a*) The Conservator shall be the controlling authority, subject to the orders of the Local Government, in all matters regarding appointment, promotion, reduction and dismissal in the subordinate branches of the Forest Service in his circle, and in matters of departmental discipline, and may address the Local Government direct on all such matters.

(*b*) The Divisional Forest Officer in charge of a forest division is *ex officio* the Assistant to the Collector, or, as the case may be, to the Assistant Collector in charge of an independent revenue sub-division.

XXIII.—The Divisional Forest Officer has, subject to the provisions of the Forest Department Code, entire control of the executive and subordinate forest staff in his division.

The officer in charge of a range is, as a rule, directly subordinate to the Divisional Forest Officer; but the Local Government may direct that he shall in the first instance be subordinate to an intermediate officer.

In the same way, the officer in charge of a beat is ordinarily directly subordinate to the Range-Officer; but, in cases where the range is exceptionally extensive, the Beat-Officer may, under the orders of the Conservator, be subordinate in the first instance to an intermediate officer.

Routine and Office work.

XXIV.—The Conservator of Forests shall correspond direct with the Divisional Officer and issue orders to him on the following subjects:—

(*a*) All matters directly relating to accounts and to expenditure and revenue in the forest division.

(*b*) All matters of a purely technical nature, such as development of trees; sowing and planting; elaboration of the system of fire-protection; valuation surveys; the collection of technical data required in the preparation of working-plans; the manner of executing thinnings or improvement cuttings; felling; converting, transport and storing of timber and firewood; the disposal of material available under working-plans; *plans-of-operations.*

(*c*) Such miscellaneous subjects as the purchase of departmental cattle, stores, tools and plant, books, maps, &c.

(*d*) Matters of discipline.

XXV.—All correspondence with the Divisional Forest Officer on other subjects shall pass through the Collector, from or through whom orders shall emanate.

XXVI.—The Collector shall, in respect of such correspondence, ordinarily forward it under flying docket after perusal. But he may, whenever he deems it necessary, record his remarks on any communication addressed to the Conservator by the Divisional Forest Officer; and he may return, for reconsideration, any instructions addressed by the Conservator to the Divisional Forest Officer, *recording* the grounds on which he asks for reconsideration.

XXVII.—Should any instructions from the Conservator to the Divisional Forest Officer be returned by the Collector, and should the Conservator, on reconsideration, not deem it right to modify his orders, the Conservator will submit the case to the superior Revenue authority, who will, if necessary, forward it for the orders of Government.

The Conservator shall be kept regularly informed of all orders issued on forest matters by the Collector and the superior Revenue authority, and shall be consulted by them

previous to the submission of important questions for the orders of Government.

XXVIII.—All orders to the executive and subordinate staff in a forest divison must emanate from the Divisional Forest Officer, or at least pass through, and be issued by, him.

XXIX.—The Divisional Forest Officer may, under the authority of the Collector, address letters and orders to subordinate Revenue and Police officers in matters in connection with which the Collector considers it convenient that the Forest Officer shall act without his intervention.

XXX.—All orders shall ordinarily reach the Range-Officer, from or through the Divisional Forest Officer. Should a superior officer give verbal instructions or orders to a Range-Officer and the Divisional Forest Officer not be present, the substance of the orders shall be communicated to the latter officer in writing. The Range-Officer shall make his reports and submit his accounts to the Divisional Forest Officer.

XXXI.—Similarly, all orders shall ordinarily reach the Beat-Officer through the Range-Officer. Should a superior officer give verbal instructions or orders to a Beat-Officer, and should the Range-Officer be absent, the substance of the orders shall be communicated to the Range-Officer in writing. The Beat-Officer shall make his reports and submit his accounts to the Range-Officer.

Diaries.

XXXII.—The Range-Officer shall, on such dates and for such periods (which under no circumstances should exceed half a month), as may be prescribed by the Divisional Forest Officer, draw up in his own hand a sufficiently full report or diary of all his movements and of all business of material interest or importance transacted by him during such period, and shall submit it to the Divisional Forest Officer.

XXXIII.—The Divisional Forest Officer shall, on the 1st and 16th of each month, draw up in his own hand a short but sufficiently full report or diary of all his movements, and of all business of material importance transacted by him during the preceding half-month. This diary shall include the substance of the more important facts recorded in the most recent diaries received from the Range-Officers, and shall be submitted to the Collector.

XXXIV.—The Collector shall forward, without delay to the Conservator, the Divisional Forest Officer's

fortnightly journal, making such remarks thereon as he may think fit.

Inspections and inspection notes. XXXV.—The Conservator may, from time to time, after inspecting the forests of any district in his circle, forward an inspection-note to the Collector, adverting more particularly to the following questions:—

Surveys and Settlements, made or in progress in his district; their cost; extent to which still required; nature and adequacy of maps and settlement records prepared; results of working under the settlements in force.

Working-Plans, already made or in progress; their cost; extent to which still required; results of working-plans in force.

Demarcation, nature and state of repair of boundary-marks; demarcation work in progress, its cost; work still to be done.

Roads, buildings, and other similar works, in existence or under construction; their cost; state of repair; new roads, buildings, or other works required.

Executive and protective staff, efficiency, state of discipline, &c.

Condition of the forests, methods of treatment employed; natural reproduction, causes which interfere with it, &c.

Protection of the forests from injury by man, by cattle, by fires, &c.; breaches of forest rules, their frequency and causes.

Works of reproduction and cultural improvements, extent, condition, and cost of plantations, made; condition of nurseries; new sowings or plantings required; thinnings, creepercutting, &c., extent to which carried on and required.

Methods of working and management in force, advantages or otherwise of methods; expenditure incurred; outturn of forests; financial results.

Timber depôt, situation and adequacy; condition in which maintained; state of records, &c.

A copy of every such note should be submitted to the Local Government by the Conservator.

Transfer to Conservator of Collector's powers and duties. XXXVI.—In compact forest areas, by the management of which the surrounding population is not appreciably affected, the Local Government may transfer to the Conservator by a general order any or all powers and duties of the Collector under these rules.

The beginnings of the Royal Botanic Gardens at Calcutta.

We have received a copy of a pamphlet recently issued from the Bengal Secretariat Press with a short account of Colonel Kyd the founder of these gardens.

Col. Kyd was born in 1746 and died in Calcutta in 1793, being then Military Secretary to Government, and a Royal Engineer. It was in 1786 that he submitted to the Governor-General his plans for making a Botanic Garden as the account says :—

"Colonel Kyd conceived the idea of supplying the Company's 'Navy with teak timber grown near the ports where *it could be* 'used in ship building, and of increasing their commercial resources 'by introducing into India the cultivation of the species which in 'those days, formed so important an item in their trade, but for 'supplies of which they had to depend on their factories in 'Sumatra and Penang. He communicated this idea to the 'Governor-General of the day ; and, in a letter written on 1st 'June 1786, he officially submitted a scheme for the establishment 'of a Botanical Garden, or Garden of Acclimatization, near 'Calcutta. This scheme also included proposals for introducing, 'into territories subject to the Company, the cultivation of cotton, 'tobacco, coffee, tea, and various other commercial products."

His proposals were very favourably received both by the then Governor-General (Sir John Macpherson who was acting after the departure of Warren Hastings,) and by the *Court of Directors and* the garden was established.

For us the most interesting matter is the idea that Col. Kyd had of growing teak near the seaport towns, and a plantation was actually made on the land which was recently the 'Bishop's College' and is now the Sibpur Engineering College. On this the account says :—

"The part of the Botanic Garden nearest to Colonel Kyd's 'house was devoted to the planting of teak trees, in accordance with 'the Company's earnest desire to supply themselves with timber 'for ship-building. The experience of thirty-four years having 'shown that good teak timber cannot be successfully raised on 'the muddy soil of the Gangetic delta, this part of the garden 'extending to about 40 acres) was in the year 1820 given up by 'Government to the Lord Bishop of Calcutta (Dr. Middleton) 'as the site of a Christian College."

Of course, it is hardly surprising that the teak did not succed, although it grows by no means badly about Calcutta. Had it been mahogany, perhaps it would have remained and there might be now a valuable piece of forest. We have heard of similar experiments as regards teak having been tried near Rangoon, but also unsuccessfully.

A Man-eater.

SIR,

As all authentic accounts about the ways of man-eaters are interesting, I asked the writer of the following letter to give me details of his recent experience, for publication in the *Indian Forester*. As it is well to fix the responsibility of all such stories, I hope my friend will permit me to give his name (Mr. P. B. Thomas of the Madras Police,) and I sign this introductory note.

VIZAGAPATAM, *10th October, 1893.* — P. W. PEET.

For over three years a man-eating tiger had been ranging through an out-of-the way corner of the Northern Circars, and for over three years no one could get a chance at the cunning brute. The country was a "big" one, well watered even in the hottest weather by several rivers that never dried up and consisting for the most part of jungle clad hills lying at an elevation of from two to four thousand feet. The country swarmed with game, principally bison, and the few villages in it lay at long distances apart, each buried in its own remote valley, and containing at the most some ten or fifteen huts.

The man-eater used to range over about 25 or 30 square miles of the country and though he shewed great audacity in his kills, frequently taking a man or woman in broad daylight in full view of the village, yet he never killed within 15 or 20 miles of his last kill, and seldom at shorter intervals than a fortnight or three weeks. He was said to be particularly partial to bison, and many a time had I felt very "creepy" when tracking them through the jungle he used to frequent ; though the natives always said of this tiger that he never attacked a party of 3 or 4 men together and seldom killed anyone in the jungles ; preferring to pounce on single unprotected people on the outskirts of a village.

Under these circumstances it is easy to understand that any systematic shikarring of the beast was out of the question. The only thing was to wait till he "gave himself away" by a lucky chance, and that chance came about in this wise.

A friend "B" and myself were encamped near a small police station in August, and having a very good time of it amongst the bison ; we had already brought a tigress to book at this camp but had only once heard of the man-eater, who had killed some 20 miles from camp. However the "khabar" was days old when it reached us so we could do nothing.

One morning I got back to camp about 12 o'clock, having been out since five after bison without finding any fresh tracks. B. was out in another direction. About one o'clock some men came in with the news that the man-eater had killed a man six miles off at ten that morning. I started off as soon as possible with an elephant and some tins of soup, and got out to the place where the man had been killed about four o'clock. He was making a a clearing in the jungle in company with two other men and seemed to have just finished felling a tree when the brute carried him off in full view of the other two men. His axe and upper cloth were still lying where he had been standing.

Without a moment's delay I followed the broad track through the grass where the body had been dragged along, sitting on the elephant, and keeping a bright look-out. Some natives followed the elephant to assist in making a machan when we found the body. This we did about half a mile off in some very thick dwarf bamboo jungle. The head was severed from the body and gnawed all over, and one leg had also been eaten. A machan was quickly constructed, and I got into it about five o'clock, sending the elephant and people away with orders to wait at the clearing where the man had been killed till they heard a shot. The elephant was then to come back for me.

It was a pouring wet night and there was no moon; so after watching till long after dark I fired a shot to call the elephant, and went back to a village some two miles off where I cooked a tin of soup and slept.

The next morning at dawn I started out again on the elephant but on getting to last nights machan we found that the body had been removed and an examination of the track showed that it had been dragged off only a very short time before we arrived; the shot I had fired in the evening probably prevented the tiger touching the kill till the early morning.

We found the body again a quarter of a mile further on. The trunk, one arm, and one leg still remained. There was a trampled space in the grass three yards in diameter, where the brute had evidently been rolling on the kill; but the body had been pulled under a small bush at a distance of 2 or 3 yards from this, evidently with the object of secreting it. It lay just above the bank of a deep nullah, with a small stream running along the bottom of it. The jungle was thin, but the grass very thick and nearly waist high. The nullah was fringed with bamboo.

We immediately made a comfortable machan in a tree some twenty yards from the trampled space alluded to and dragged the body into the middle of this space. This took about an hour, as I expected to have to wait all day and took care to make the machan big and shady, the day being hot. An old Police Head

Constable with me then produced three leaves of the "maddi" tree and seven leaves resembling those of an English lime tree in shape, only bigger and coarser. These leaves he placed under the body with great care telling me that it was quite hopeless to expect a shot unless this little arrangement was made.

He and I then got into the machan, telling the other men to go away with the elephant talking as they went. They did so, and all was silence. The Head Constable whispered to me that we had better take it in turns to watch, as the tiger was very unlikely to come till the evening.

We had been watching barely twenty minutes before I heard a rustle in the grass right in front of the machan, and in another second a magnificent tiger walked quickly out of the nullah, and stood for a moment on the bank. He was too much covered by jungle to give a certain shot so I sat motionless. He then turned sharp across me, and moved towards the trampled space where the body lay, exposing his shoulder fully. I raised my express quietly, but his eye caught the motion at once, and he looked quickly up towards us. I could only see half his head round the corner of a bamboo, and hesitated whether to shoot or not, but luckily he had not made me out and moved his head to get a better view, thereby exposing it completely. I immediately put in a bullet over the right eye, which rolled him over and as he lay kicking, another into the white of his belly. He still kicked, and I was not going to let him get up if I could help it, I put in four more shots; kept on at him in fact till he stopped kicking.

We then summoned the elephant and went up to him giving him a shot in the head to make all sure, as he was still breathing.

He was a fine tiger in perfect condition. Two of his fangs were broken, and were mere stumps, but he had nothing about him to account for his being a man-eater. He was very fat, and a heavy animal, 20 inches round the forearm but his length was only 9 ft. 5 in. However it was as much as we could do to pad him, even after he had been cleaned.

The record of kills attributed to this tiger from January 1891, to the date on which he was shot, was 45. He had on two occasions killed two women together, though he ate only one on each occasion. He had killed several people previously to 1891, but I do not know how many. I think that his singular want of wariness on the occasion on which he met his death was due to his never having been driven off a kill before. All that had ever been found of his previous victims were the bones. I do not think he had ever been shot at before, and there were no old bullet marks on him anywhere. He was probably one of a litter that had been brought up to man-eating.

P. B. T.

The Adirondack Park.

There must have been some public interest in the woodlands of this state considerably more than half a century ago, or Governor DeWitt Clinton would not have sent a message to the Legislature in which he insisted upon the importance of sustaining the productive capacity of its forests. This sentiment had grown so strong by 1872 that a Commission with Horatio Seymour at its head, was appointed to enquire into the expediency of legislation for vesting in the State the title to the timbered Adirondack region and converting it into a public park. It would have been comparatively easy then to acquire these lands, but public opinion was not ripe for the project and as acre after acre of the forest has disappeared, the difficulties in the way of rescuing what remains have become greater and greater. The bill drawn up with care by the Commission of '85 was not adopted, and a substitute containing only a few of its features was enacted, but the destruction of the timber and the absorption of the land by various corporations and individuals has gone on as before. This imperfect scheme has now been superseded by another plan of administering the state forest-lands, embodied in a bill to which Governor Flower has just affixed his signature. How much this will accomplish in the way of saving the remnants of the North Woods depends largely on the intelligence and the executive force of the forest-commission just named. The measure is not such a one as has been recommended by those who have given the most study to the subject, but it may embody most of the protective provisions which it is possible to enforce until public opinion becomes more thoroughly educated. We have often expressed the opinion that a forest tract which is such an important factor in the welfare of the entire community as the North Woods should belong to the community, and that state ownership in fee-simple is, therefore, the only final and satisfactory solution of the problems involved.

The first part of the act just passed relates to all the forest-preserves throughout the State, but the important part of the law is that concerning the Adirondack Park, which sets apart certain townships in the countries of Hamilton, Franklin, Herkimer, St. Lawrence and Warren to be held in forest for the preservation of the chief rivers of the State and its future timber-supply and for the free use of the people for their health and pleasure. The State already owns a half-million acres within the boundaries of this park, and the novel feature of the bill is an effort to gain control of about as much more land for Park purposes, while leaving it to be owned as it now is by private individuals. The proposed convenient is, that in return for the remission of taxes on these lands by the State their owners shall contract to refrain forever from removing any of the timber thereon which is less than twelve inches in diameter at a height of three feet above the ground, except that the owners have the right of clearing for domestic purposes one acre in each one hundred of forest-land covered by the contract. The commissions also have the authority to issue leases of not more than five acres in one parcel for the erection of camps or cottages under conditions prescribed by them. They are also empowered to sell fallen timber and timber "injured by blight or fire," and *standing timber which* shall measure twelve inches or more in diameter three feet from the ground, the proceeds of which shall be credited to the fund for purchasing other land within Adirondack Park. They have the the power to sell the portions of the 250,000 acres of forest-land owned by the state without the Park and to apply the money thus received to the purchase of land within the park, and they may exchange directly State lands without the park for lands within its boundary. Finally, they may buy lands within the park and leave the present owners the privilege of cutting down timber above the regulation size for fifteen years. This is an attempt at the gradual acquisition by the State of land which it is considered too expensive to take at once.

As we have said, the immediate value of this legislation depends on the quality of the commission just appointed. The power to lease tracts for camp-grounds and to make compacts for a divided ownership of the land may result in the establishment *of many small parks which are practically private property*, or in which the people have, at most, but few rights. The privilege to sell large timber is dangerous. If the proper method of cutting and transporting this is not strictly prescribed and enforced, great damage may be done to the smaller trees. No doubt, it is right for the State to sell its forest-products, for this is the only legitimate revenue which can be expected from the land. But this should only be done under the supervision of trained foresters, and with such men in charge there would be no need of fixing a limit to the size of the trees to be cut. A skilled forest-master knows what trees to cut, whether they are large or small, without any assistance

from Legislature. In many instances, for example, it would be advisable to thin out small trees of inferior kinds to aid the growth *of better kinds. For the present, however the restriction as to the* diameter of timber felled may be on the side of safety. It would be easy to criticise other details of the Act. But if a better law would fail of enforcement, owing to the lack of enlightened popular sentiment behind it, and if it is impossible to find men to whose charge the forest can safely be entrusted, the proper attitude now of all patriotic citizens is to encourage the commissioners in well-doing as they deserve it, to watch their conduct closely and point out mistakes of administration when they are made, and to continue through the press and otherwise to educate the people as to the vital importance of this forest to them and their children, until they are jealous of the slightest encroachment upon their right to have it preserved and perpetuated.—(*Garden and Forest.*

World's Fair Notes.

The following Extract from the Chicago 'Evening Journal' was sent to one of our correspondents by W. H. Norman Tod of the Forestry Building, World's Fair.

People who live south of the World's Fair grounds and enter by the extreme south eastern gate catch a good many exhibits missed by the men who enter by the Esquimaux village three miles away. After tramping across sand and prairie from their hotels, they show a predilection for sitting on the shady side of the Forestry Building and resting awhile before commencing the serious task of examining the Exposition. Almost invariably they enter the Forestry Building, and, if they are people of taste, with eyes which appreciate beautiful things, remain there until they have mastered its contents.

There has never before been seen such a show of woods, in he rough and finished states, as this building contains. It is self constructed of an immense variety of woods collected from very State in the Union. Interesting as this may be to the lumer man and builder, they do not catch the eye of the visitor who s looking for the beautiful and the curious as do the specimen wo ods exhibited within. Here again the States are represented and many of the countries of the world. There is instruction and education in even a cursory glance at the exhibits; but if the

visitor is inclined to go deeper and seek information from the men in charge, there is more to be learned than a week's study will enable him to assimilate.

India's Exhibit Interesting.

Especially fruitful of interest is the exhibit made by British India. As a Government exhibit, in which private enterprise is in no way interested, it is both complete and authoritative. It illustrates not only the varieties of woods found in British India, but also the methods used in the Department of Forestry, which is fast becoming considered as important as any great governmental enterprise. Outside of the mercantile value of the timber, the chief interest of the exhibit for American visitors lies in the fact that the science of forestry as practiced in India affords a great many practical lessons for the United States. Here, as there, the destruction of timber lands is becoming an important question both on account of its influence on the climate and the lessening of a very necessary commercial product, and many of the same remedies apply to both. Forestry in India is a comparatively modern institution. There can be little doubt that in prehistoric times when the climate of the country was less fierce than now, the greater part of the country was covered with dense forests but the hands of invading hordes from the north were perpetually turned against them, and thousands of square miles disappeared by fire. When the English took possession, a new impetus was given to the destruction of forest as further vast areas were denuded to increase the area of cultivation. There soon came a time, however, when the attention of the Government was drawn to the lessening of the forests by the lack of timber in certain districts for public works.

Forestry made a Science.

Then the Forest Department came into existence and forestry became a science in India. Acts were passed for the creation of Government reserves, for the constitution of village forests and for the provision of police rules necessary for the protection of forests and forest produce. The department was officered by men who had received training in scientific forestry in England, France and Germany. Most Indian forests are of a mixed character, containing only one or a few valuable species which will repay the cost of working. Contractors handle the products of Government forests under the supervision of department officals. The deciduous forests, which occupy the greater part of the peninsula, Burmah, and the Andaman islands, are of the greatest importance for the forester, the consumer, and the Government. They contain well-known and valuable species of timber, such as teak, sal, ironwood

sandalwood, red sanders and padouk. The first and the last named have the most promising future. Padouk, or "vermillion," as it is called by American importers, is reckoned a better wood than teak, lasting longer and being handsomer. It is the best wood for carriage building and will one day rival mahogany for cabinet work. Teak takes the first place, however, in the estimation of visitors to India's section in the Forestry Building, for from it has been carved a magnificent doorway which is the equal of the best wood-carving to be found in the Exposition. This is the work of a Burmese carver in Mandalay and was executed by him to the order of the Conservator of Forests for Upper Burmah.

Beautiful Specimen of Carving.

The general outlines and designs are the same as those used in the throne of the King of Burmah. It stands fourteen feet high and is proportionately broad. Every inch of post and lintel and folding doors is carved with curious mythological figures, images of Buddha and minor deities. Below, it is supported by two dragons, which, as do all the figures, display more than a trace of Chinese art, induced by the intercourse between China and Upper Burmah. The best carving is contained in a triangular space above the door, which is designed to show the city of Mandalay with the King and his courtiers. Of three tiers in the triangle, the first shows one of the famous seven gates of the city surrounded and guarded by evil spirits; the second shows the King's ministers, and the highest tier the King and his Queens in the palace. Other valuable pieces of carving are exhibited to show to what uses India's woods may be put. A mantelpiece made of half a dozen varieties was wholly designed and carved by the Sikh carpenters. A cabinet and tables show what a fine polish padouk will take; and two stands for flower vases are carved in representation of a pelican standing upon four turtles.

For the student, a variety of maps, diagrams and instruments illustrate the methods employed in mapping out forest areas and the precautions taken against fire. Commercial men will find besides the timbers a full exhibit of tree products, resins, oil and gums.

Another correspondent has kindly sent us the following cutting from the Chicago 'Daily Inter-Ocean' regarding the carved teak doorway which was sent as an exhibit to the World's Fair by the Burma Forest Department. We feel sure that it will amuse our readers as it has amused us. Our Madras readers will not fail to be surprised at the antiquity of Vijianagar; our Burma subscribers will not less be astonished to hear that the Kings of Burma were Hindoos and our Insp ector-General will read with some amazement how the great doorway was carved in the snug recesses of his Simla retreat.

Wood Carving in India.

Art attracts in the Indian exhibit, adjoining the Japanese at the north end of the building. Native workmen and native wood have combined to present an exhibit, which would be numbered among "the seven wonders of the world," were they to be named and grouped at the Columbian Exposition. The exhibit consists of a massive double door, with lintel, sill and frame, carved from teak wood. Ponderous, high and wide, the carving has been so daintily wrought that the doors look as if they were web and the whole piece looks frail and perishable, while in fact doors, frame and the handiwork of the craftsmen is durable as time, for teak wood is as imperishable as bronze, more enduring, for just alongside of these doors is a handsomely carved mantelpiece, cut, chiseled and polished from teak wood 600 years old; hopwood, walnut, and fragments of blackwood, the Shisham of the Bible, taken from the ruins of the presidency of Madras, whose erection ante-dates the Christian era.

The teak doors are most elaborately and skillfully carved; figures, mythological, allegorical and representative abound. Scenes about Mandalay, the capital of Upper Burmah, are portrayed; the king enthroned, surrounded by courtiers; heraldic accounts and legends are carved in relief while the figures great and minute are surrounded by intricately wrought scrolls and delicate tracing, lace-like in fineness. The doors are the reproduction of the entrance to the palace at Mandalay, made of the same wood and which have swung to and fro for many, many generations of Hindoos. The reproduction is the work of six native carpenters who carved the gigantic doors at Ava Lodge, Simla, under the supervision of the British Conservator of Forests of the Eastern Circle of Upper Burmah.

India, divided into the presidencies of Bombay, Bengal and Madras, has a large exhibit, every district of the vast empire being represented. Teak, yellow and black in color, a tough, fine-grained and everlasting wood, is commercially the most valuable, and while suitable for furniture, is so universally useful that in ship-building it is found to have no equal to stand the buffeting of storms, the change of climate and the encroachments of boring sea insects. Having an inexhaustible forest supply, the woods of India are countless in variety, valuable commercially and there is scarce a variety that is not serviceable. Childhood's geography has pictured the famous banyan tree, whose branches stretch out, descend and taking root again, make an arcade of shade. This tree is the most useful on earth for shade purposes, and in a country where the sun is ever in an angry mood, red hot, has its rivals among the merchantable woods of the river valleys and the mountain ranges of Hindostan.